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# **Agilent M1205A**

## **V24 and V26**

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## **Service Guide**



**Agilent Technologies**

Part No. M1205-9303L

Printed June 2000

Third Edition

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# Overview

The *Agilent M1205A V24/V26 Series Service Guide* is a combined reference guide and self-paced course featuring chapters on how to test, troubleshoot, and repair the monochrome Model V24, the color Model V24C/V26C, and the color battery Model V24CT/V26CT.

The Agilent M1205A monochrome Model V24, color Model V24C/V26C, and color battery Model V24CT/V26CT will be referred to throughout this guide as “instrument”, “V24”, “V24C/V26C”, or “V24CT/V26CT” (as appropriate).

## Target Audience

This self-paced training and reference guide is intended for hospital Biomedical Engineers and Technicians, Agilent Customer Engineers, Response Center Engineers, and Installation Planning Specialists who have experience servicing Agilent patient monitoring devices or similar products.

## Prerequisites

You should also have successfully completed the *Agilent M1205A V24/V26 Series Concepts Training and Reference* manual contained in the *Service Training Kit* or equivalent experience servicing patient monitors prior to completing this self-paced course.

## Course Objectives

- Identify and describe all of the major components of the instrument.
- Maintain the instrument by performing the following tasks:
  - Test requirements
  - Performance assurance test
  - Patient safety checks
  - Preventive maintenance
  - Recommended maintenance
  - Thermal Recorder Module Maintenance
- Identify the cause of operational errors which may occur in the V24/V26 Series.
- Diagnose and isolate hardware failures at the level of the field replaceable part.
- Perform removal and replacement procedures for each field replaceable part.
- Identify the replaceable components of the V24/V26 Series and know which subassemblies you can order.

## Maintenance Philosophy

The monochrome Model V24, color Model V24C/V26C, and color battery Model V24CT/V26CT are maintained using one of two service strategies:

- 1 **On-site maintenance.** This support philosophy is board or assembly replacement through the Support Materials Organization (SMO).
- 2 **5-Year Rapid Repair Warranty Service.** This support philosophy provides unit repair service through a mail-in program. See the *User Guide for 5 Year Rapid Repair Warranty Service* for further details (available only in U.S.).

## In This Guide

**Chapter 1 Introducing the Agilent V24/V26 Series** provides a physical/functional overview to the instrument.

**Chapter 2 Testing & Maintaining the Instrument** describes how to test, maintain and check that the instrument operates in an optimum condition and how to perform patient safety checks.

**Chapter 3 Troubleshooting the V24/V26 Series** provides troubleshooting and diagnostic procedures for all models.

**Chapter 4 Using Support Functions** describes how to troubleshoot problems using error codes and other support functions.

**Chapter 5 Troubleshooting Plug-in Modules** provides troubleshooting procedures and specification tests for the parameter modules.

**Chapter 6 Repairing the Model V24** includes replacing the field replaceable parts and other repair procedures for the monochrome Model V24.

**Chapter 7 Repairing the Model V24C/V26C** includes replacing the field replaceable parts and other repair procedures for the color Model V24C/V26C.

**Chapter 8 Repairing the Model V24CT/V26CT** includes replacing the field replaceable parts and other repair procedures for the color battery Model V24CT/V26CT.

**Chapter 9 Other Repair Procedures** includes removing and replacing the front housing assembly on Model V24C/V26C and V24CT/V26CT.

**Chapter 10 Removing and Replacing Plug-in Modules** provides information on the removal and replacement of Plug-in Modules.

**Chapter 11 Replacement Parts** lists replacement and exchange part numbers for the monochrome Model V24, the color Model V24C/V26C, and the color battery Model V24CT/V26CT.

## **How to Use This Guide**

- 1** You begin the course by viewing the videotape. The videotape presentation will cover important points to remember when configuring, repairing, and troubleshooting the instrument. The video presentation also provides an overview of the key functions and features of the instrument.
- 2** At the end of viewing the videotape, review each chapter in the Service Guide.
- 3** Answer the Practice Exercise questions at the end of the chapter. You can check your understanding of the contents of each chapter by comparing your answers to the answers provided on the last page of the chapter.
- 4** You can complete each unit without having any equipment available. However, access to an instrument is preferable to allow you to practice the procedures described in the Service Guide.
- 5** Complete the Final Exam at the end of this course using the answer sheet contained in the *Service Training Kit*. Mail in your answers by following the instructions on the Final Exam. You will receive a certificate of completion after successfully completing the Final Exam.



# Chapter 1 Introducing the Agilent V24/V26 Series

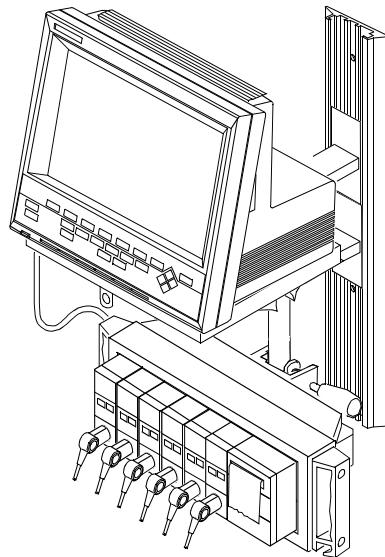
## Objective

After reading this chapter and completing the Practice Exercise, you will be able to identify and describe all of the major components and features of the Agilent Model V24, the Agilent Model V24C/V26C, and the Agilent Model V24CT/V26CT.

## In this chapter

You will become familiar with the physical and functional characteristics of the monochrome Model V24, the color Model V24C/V26C, and the color battery Model V24CT/V26CT. This chapter also provides you with an overview of all instruments' features, component description, and specifications.

Topics in this Chapter	See Page	Topics in this Chapter	See Page
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Physical, Functional Overview	1-4	Specifications	1-17
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RS-232 Network	1-16	Practice Exercise Answers	1-23



**Figure 1-1 Agilent V24/V26 Series**

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## Features

Some of the following features are release-dependent. For further information, see the appropriate *Technical Data Sheet*.

- Flexible configuration and optional battery (Model V24CT/V26CT) permit monitoring patients in most critical and acute patient care areas of a hospital as well as in transport situations.
- Displays up to four waves on a monochrome, or up to six waves on a color flat panel display.
- Compatible with either the 6- or 8-slot Plug-in Satellite Rack. 6-slot rack docked configuration available with Model V24CT/V26CT.
- Movable design includes built-in handle, lightweight and rugged construction.
- Small footprint requires little space to mount on table top, wall, shelf, or roll stand.
- Compatible with Agilent parameter modules and recorder module (except EEG, FiO<sub>2</sub> and SvO<sub>2</sub> modules).
- Operation consistent with all Agilent Component Monitoring Systems, including set-up, configuration, other patients (overview) and record procedures.

- Compatible with the Agilent patient care system.
- Comprehensive Patient Data Management provides 24-hour storage of up to 16 continuously monitored parameters sampled at one-minute intervals.
- Offers optional ST Segment Analysis software which measures the elevation or depression of the ST segment on up to 3 ECG leads and provides waveform recall capability.
- NBP measurements synchronized on a full hour.
- Displays three oxyCRG waveforms over a six-minute period.
- Neonatal Event Review to automatically detect, store, display and document up to 24 neonatal cardiorespiratory and hypoxic events over a period of 24 hours. Events can be manually selected and stored, and print-outs of neo-events and oxyCRG can be done at local or central printer.
- Neonatal event review print-out capability
- Basic arrhythmia in the bedside monitor; enhanced arrhythmia monitoring via Agilent patient care system connection to a host of Agilent arrhythmia monitoring systems.
- Point-of-care Blood Analysis module, using single-use disposable cartridges.
- Desaturation alarm.
- Recordings available using the thermal array recorder module, and through Central Station recorders.
- 12-lead ECG derived using the EASI™ algorithm<sup>1</sup>, requiring only the standard 5-lead set.
- EASI<sup>1</sup> print-out capability for 12-lead EASI<sup>1</sup> ECG
- Improved performance of the SpO<sub>2</sub> algorithm providing a more reliable measurement at low perfusion and during patient movement.
- New appearance of screen elements including softkeys and task windows gives the look and feel of the latest graphical user interface.
- Five screen configurations, each including the application window (including oxyCRG, split-screen, CSA) and numerics on/off.
- Venous puncture facility with the NBP module, used for drawing blood or applying venous lines – the patient cuff is inflated to a patient size-dependent pressure for a predefined period of time.
- Inexpensive to maintain and low cost of ownership. Optional no charge 5-year return-to-Agilent warranty repair service available (U.S. only).
- Editable screen labels

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1. EASI is a trademark of Zymed Inc.

## Physical, Functional Overview

The Agilent V24/V26 Series is a versatile patient monitoring system, allowing user-specific customization using a variety of hardware and software components.

These components include:

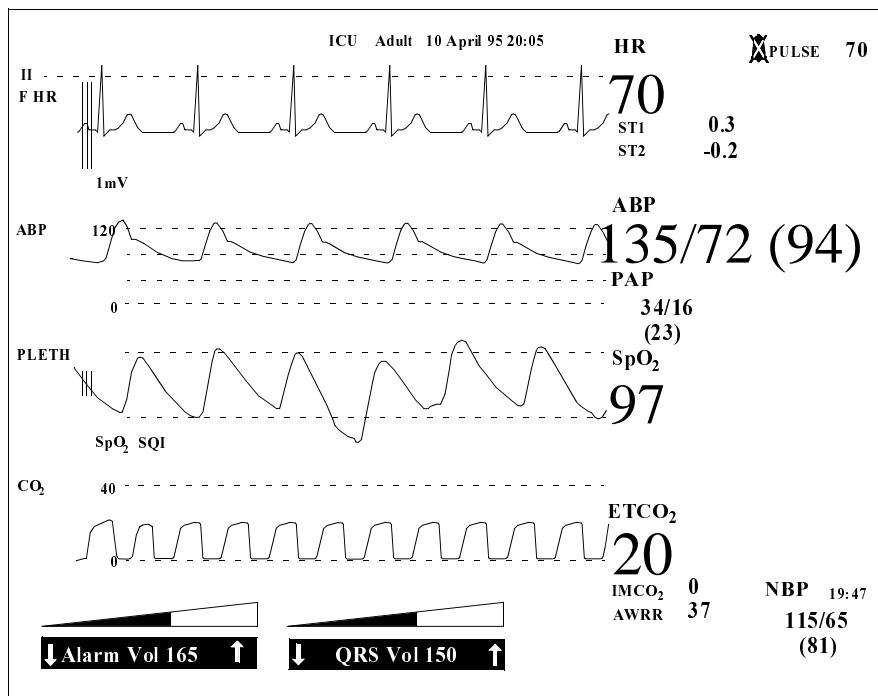
- Mainframe
- Monochrome or Color Flat Panel for display of up to six waveforms
- Eight-slot Satellite Rack or optional six-slot Plug-in Satellite Rack
- All parameter modules (except EEG, FiO<sub>2</sub> and SvO<sub>2</sub>) supported by Agilent M1165A/66A/67A and M1175A/76A/77A Component Monitoring System, and Agilent M1275A Component Transport System
- Agilent patient care system interface
- RS-232 Serial Interface (optional)
- Patient Data Management software
- ST segment analysis software
- OxyCRG display software
- Basic arrhythmia
- Extended arrhythmia detection when networked to one of Agilent's Arrhythmia Systems
- Agilent M1026A Anesthesia Gas Module (AGM) support
- Two sealed lead acid rechargeable batteries (Model V24CT/V26CT)
- Model V24CT/V26CT can be operated on AC power or battery.

### Mainframe

The mainframe contains the display unit and computer module which controls all parameter inputs, display output and interfacing capabilities for the Agilent V24/V26 Series.

### Display

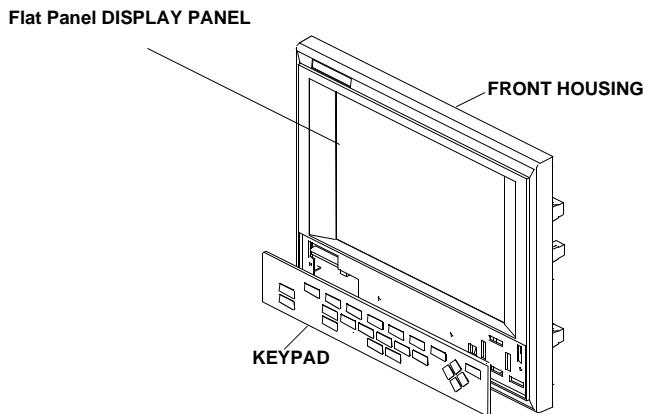
The Agilent Models V24/V24C/V24CT allows 4 simultaneous waveforms, and the Models V26C/V26CT up to 6 simultaneous waveforms, in fixed trace mode. Moving trace mode is supported for Cardiac Output waveform, oxyCRG and trends. Overlapped wave format is supported for the bottom 2 waves only (maximum of 2 waves may be overlapped with the waves differentiated by dashed lines).

**Figure 1-2. Example of Main Screen Display**

The Flat Panel display assembly consists of a backlit, high-contrast monochrome or color panel with an anti-glare screen for superior readability.

The monochrome display consists of a 9.5" (diagonal measurement) monochrome display. The display is a 640 x 480 pixel full dot graphic display unit consisting of the Flat Panel display, Cold Cathode Fluorescent Tube (CCFT) for backlighting, and Flat Panel row and column driver circuits.

The old and the new color displays consist of a 10.4" (diagonal measurement) color Flat Panel display. The display is a 640 x 480 pixel full dot graphic display unit consisting of a TFT Active Matrix Color Flat Panel.

**Figure 1-3. Agilent V24/V26 Series Display (Front View)**

## System Board

The microprocessors for the Agilent V24/V26 Series are all contained on the System Board. The System Board contains the circuitry to control all key operational functions including:

- Acquire and process all physiological data from the plug-in parameter modules.
- Control all outputs to the Flat Panel display.
- Process the inputs created by keystrokes from the front panel keypad.
- Create tones for audible alarms.
- Interface to the Agilent monitoring network (SDN) system.

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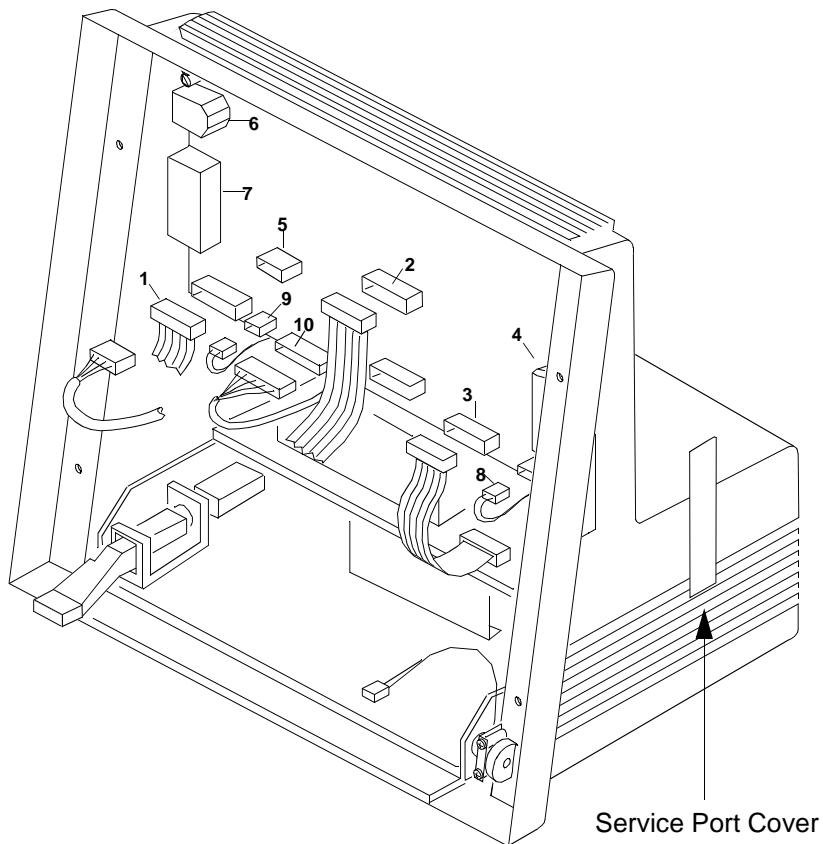
**NOTE**


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If you have the SDN daughter card installed in your Model V24, it will be different than the one shown in the illustration. Refer to Appendix A for information on the Model V24 with the Agilent monitoring network (SDN) daughter card.

### System Board interface connectors:

1. Keypad connector
2. Flat Panel Data Connector
3. 5V and 12V power supply connector
4. Service ports (not cabled)
5. SDN interface cable
6. Defib sync connector (not cabled)
7. Front-end link connector
8. Speaker connector
9. 60 VDC power supply connector
10. RS-232 connector (with option J13)



**Figure 1-4. Instrument shown with Front Panel removed**

## Interface Connections

The System Board controls all interfaces to the instrument including:

### **Agilent Patient Care System Network**

A single upstream Agilent monitoring network (SDN) connector allows connection to an Agilent patient care system network. This allows the V24/V26 Series to access waveforms, numerics, and alarms from other networked patient monitoring bedsides. It also allows connection to an Agilent central station and Agilent extended arrhythmia monitoring systems.

### **RS-232 Interface**

A single RS-232 connector allows connection to the MEdical Computer InterFace (MECIF). This allows the V24/V26 Series to transfer data from the system to a MECIF compatible device or Agilent M1026A Anesthesia Gas Module (AGM). Alternatively the RS-232 port can be used to connect to a local printer to provide local printing capability.

### **Front-End Link**

The plug-in rack is connected to the mainframe by a cable that plugs into a serial front-end link connector located on the side of the V24/V26 Series.

### **Service Ports**

The V24/V26 Series application and utility processors have dedicated service ports. Each service port allows connection to the CPC Flash Programming Tool, which is used for configuring the instrument and upgrading product software. The CPC Flash Programming Tool is a compact service tool which executes software stored on a Flash Memory Card and is used with other Agilent patient monitors. For details on using the CPC Flash Programming Tool refer to Chapter 2 Testing & Maintaining the Agilent V24/V26 Series

### **Defibrillator Sync Output Connector**

The patient monitor includes a side panel analog jack output for ECG signal, Defibrillator and balloon pump sync signal and defib marker insertion. The ECG output specifications are:

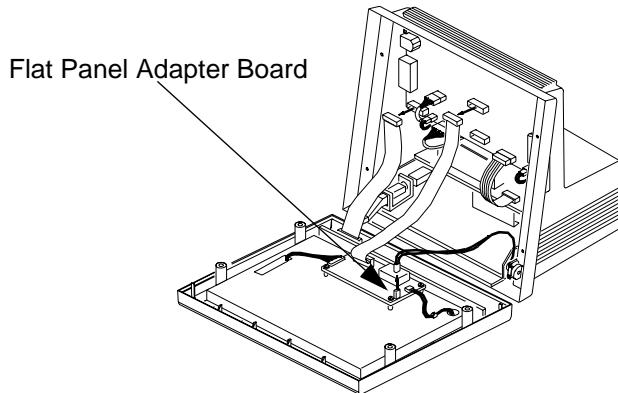
- Signal gain: 320 to 3200 depending on display gain
- Full scale display: 3.2 V<sub>pp</sub>
- Signal delay: <30 ms

### **AC Power Connector**

A standard CEE connector (IEC Type 320) is located at the rear of the V24/V26 Series. A detachable country-specific line cord is supplied.

## Flat Panel Adapter Board

The Monochrome Model V24 Flat Panel adapter board provides an interface between the monochrome Flat Panel display assembly and System Board. The board contains the backlight inverter assembly, Flat Panel bias and contrast/brightness circuitry.



**Figure 1-5. Flat Panel Adapter Board**

## Power Supply

The Agilent V24/V26 Series power supplies convert input power into three DC voltages for the mainframe and for the plug-in modules in the plug-in rack.

The Model V24CT/V26CT can operate from an internal battery power supply, or from an external AC source. The internal power is provided by two rechargeable, removable batteries.

The batteries are 12 Volt, 2.3 Amp-Hour, sealed lead acid batteries. The battery's rate of discharge is dependent on the number and type of modules being used with the monitor.

The batteries are charged while the monitor is plugged in to an external AC source. Depleted batteries should be charged as soon as possible. When using the external AC source, the recharge time takes approximately 4 hours to a 90% capacity if the monitor is off. If the monitor is on, the charge time takes considerably longer (approximately 16 hours). An alternative method for recharging the batteries is to remove the batteries from the monitor and charge them using the Agilent M1278A External Battery Charger. The M1278A charges up to 4 batteries at a time and reduces the charge time to 2.5 hours.

### Power Supply Output Voltage

The following table depicts the slight Power Supply output voltage differences between the monochrome Model V24, color Model V24C/V26C, and color battery Model V24/V26.

Monochrome Model V24	Color Model V24C/V26C	Color Model V24CT/V26CT
+5 Volts @ 2.0 Amps, max	+5 Volts @ 2.5 Amps, max	+5 Volts @ 2.8 Amps, max
+12 Volts @ 2.0 Amps, max	+12 Volts @ 0.75 Amps, max	+12 Volts @ 0.65 Amps, max
+60 Volts @ 0.35 Amps, max	+60 Volts @ 0.35 Amps, max	+60 Volts @ 0.3 Amps, max

### Power Supply Input Voltage

The power supply uses the following input voltages:

- AC Input: 90 to 250 VAC continuous, 48 to 66 Hz
- Maximum Power Consumption: 150 Volt-Amperes

### Battery Power Supply

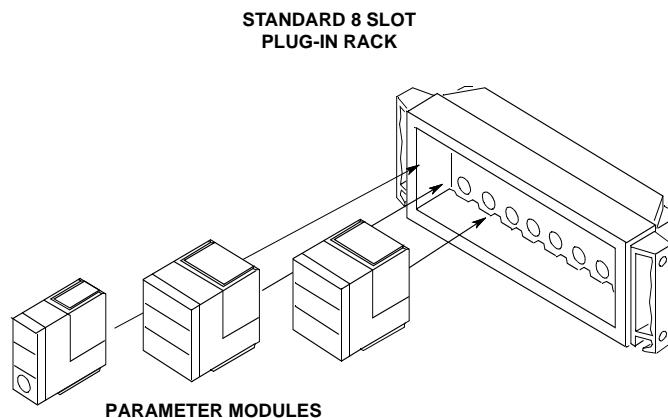
Capacity: At least 1 hour on full charge at 25°C (77°F) with two batteries. For example, the discharge time for the module configuration option #A24 (with ECG/Resp, NBP, SpO<sub>2</sub>, Pressure, Recorder) is 1 hour. The discharge time for the module configuration option #A22 (with ECG/Resp, NBP, SpO<sub>2</sub>, Pressure) is 1 hour 15 minutes.

Charging time: 4 hours to 90% of full capacity if monitor is off. 16 hours to 90% of full capacity if monitor is on.

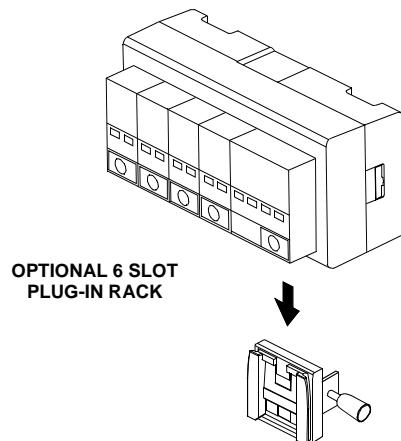
If the Agilent Battery Charger (M1278A) is used, the charging time is 2.5 hours to 90% capacity.

## Plug-in Satellite Rack

The 6- or 8-slot Plug-in Satellite Rack houses parameter modules and connects to the mainframe by a standard front end cable. The rack may be conveniently mounted on IV pole or patient's bedside.



**Figure 1-6. Eight Slot Plug-in Rack**



**Figure 1-7. Six Slot Plug-in Rack**

---

### WARNING

**Do not connect a second rack by a cable when using a module rack docked to the back of the Agilent Model V24CT/V26CT. Using a second rack connected by a cable may disrupt module communication.**

## Parameter Modules

The Agilent V24/V26 Series provides 6 or 8 slots to support the following parameter modules (Release C.0):.

Model Number	Parameter Module	Number Supported
M1001A/B	ECG	Maximum of one M1001A/B or M1002A/B per monitor.
M1002A/B	ECG/RESP	
M1006A/B	Pressure (invasive)	Maximum of three per monitor *
M1006A/B Option #C01	Pressure (invasive) Module with Analog Pressure Output	Maximum of one per monitor (total of three invasive pressure modules possible) *
M1008A	NBP	Maximum of one per monitor *
M1008B	NBP Adult/Neonatal	
M1012A	Cardiac Output	Maximum of one per monitor *
M1015A	Sidestream CO <sub>2</sub>	Maximum of one per monitor *
M1016A	CO <sub>2</sub>	
M1018A	tcpO <sub>2</sub> /tcpCO <sub>2</sub>	Maximum of one per monitor – only with Neonatal options
M1020A	SpO <sub>2</sub> /PLETH	Maximum of one per monitor
M1029A	Temperature	Maximum of two per monitor *
M1032A	VueLink	Maximum of one VueLink A and one/two VueLink B per monitor *
M1116A or M1116B	Thermal Array Recorder	Maximum of one per monitor
1026A	Anesthetic Gas Module	Maximum of one per monitor – only with Anesthesia options *
1022A	Blood Analysis Module	Maximum of one per monitor *
M1034A	BIS Module	Maximum of one per monitor - only with Anesthesia options *

\* Bundle-specific

### NOTE

For details of performance specifications of each parameter module see the relevant *Technical Data Sheet*.

## Front Panel

The Agilent V24/V26 Series front panel contains the controls and indicators which operate the instrument. The front panel comprises softkeys and hardkeys. The softkeys perform multiple functions which correspond to labels displayed at the bottom of the screen. When no softkey labels are on the screen, the softkeys do not function. The hardkeys perform the function defined by the key. There are two types of hardkeys:

- Blue hardkeys – Each of these hardkeys displays specific selection windows where adjustments and changes can be made.
- Gray hardkeys – Each of these hardkeys performs the specific action indicated by the label.

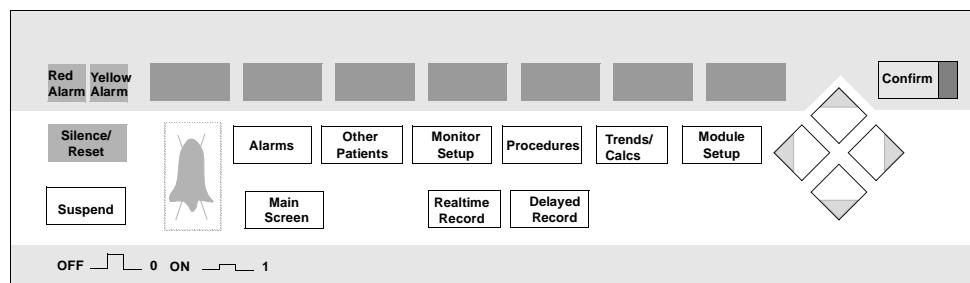


Figure 1-8. Agilent Models V24, V24C, V26C Front Panel

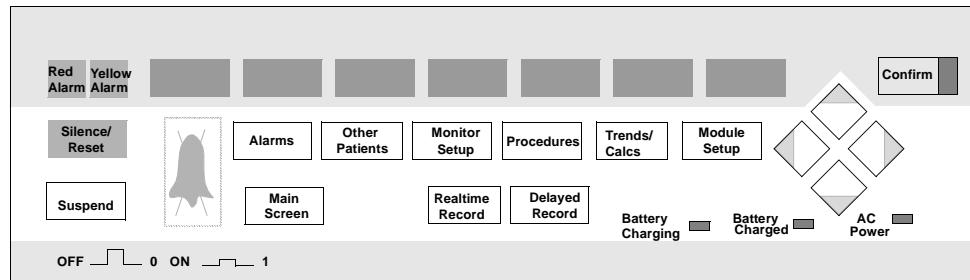


Figure 1-9. Agilent Model V24CT/V26CT Front Panel

The Agilent Model V24CT/V26CT front panel shows the status of the battery and line power supplies. See “Agilent Model V24CT/V26CT Front Panel Indicators” on page 1-14 for indicator descriptions.

## Hardkey Functions

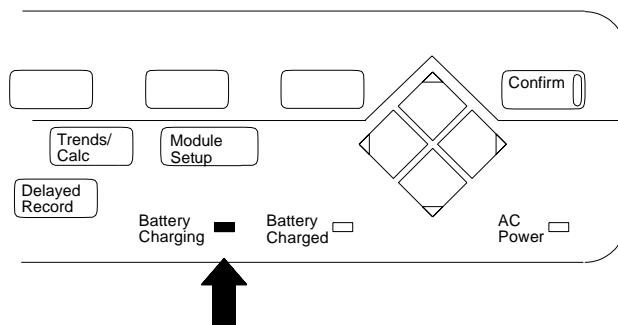
The following table describe the hardkey functions:

**Table 1-1. Front Panel Hardkey Functions**

Hardkey	Description
Alarms	Pressing this key displays a selection window that allows alarms to be suspended or switched on; allows alarm limits to be set and reviewed.
Suspend	Pressing this key toggles the Alarms Suspend state.
Silence/Reset	Pressing this key silences an alarm. If the cause of the alarm has been eliminated, pressing this key resets the alarm.
Monitor Setup	Pressing this key displays a selection window that allows various monitor setups including changing the display layout. You may select/assign specific waveforms and the mode in which they are displayed, for example, four waves non-overlapping, or four waves with the bottom two waves overlapped.
Procedures	Pressing this key allows you to review the patient's Current Height (length for neonates) and Current Weight entry for cardiac index calculation. The values for the patient height and weight are adjusted using the arrow keys to increment or decrement the currently selected line. This key also gives access to ST and CO if available.
Trends/ Calcs	Pressing this key displays a selection window for reviewing several patient data screens including Table Display, Graphs Display, Review Admit, Trending Priority, Arrhythmia, Reports, oxyCRG, etc.
Module Setup	Pressing this key displays a selection window that allows you to change or adjust parameter settings such as turn parameters on or off, change source for heart rate/pulse, etc.
Main Screen	Pressing this key returns the display to the standard monitoring screen.
Realtime Record	Pressing this key generates a real-time recording.
Delayed Record	Pressing this key generates a delayed recording.
Arrow Keys	The arrows consist of up/down/left/right keys. These keys function only when illuminated. The arrow keys allow you to move between different areas of the operator screens to make selections, perform procedures, or adjust settings.
Confirm Key	Pressing the Confirm Key confirms and enters configuration changes you make to the instrument. The confirm key works only when illuminated. When completing your changes to the configuration, a message appears on the screen prompting you to press the key.
Other Patients	Pressing this key allows you to access Overview Controls and send and receive alarms at selected groups.

**NOTE**

For additional information on the hardkey functions and operating procedures, refer to the *Agilent V24/V26 Series User's Guide*. For information on configuring the Agilent V24/V26 Series, refer to the *Agilent V24/V26 Series Installation and Configuration Guide*.

**Agilent Model V24CT/V26CT Front Panel Indicators**

The front panel of the Model V24CT/V26CT has the following indicators:

- AC Power - indicates the Model V24CT/V26CT is connected to an AC power source.
- Battery Charged - indicates the batteries are charged and can support battery operation.
- Battery Charging - indicates the Model V24CT/V26CT is connected to an AC power source and the batteries are being charged.

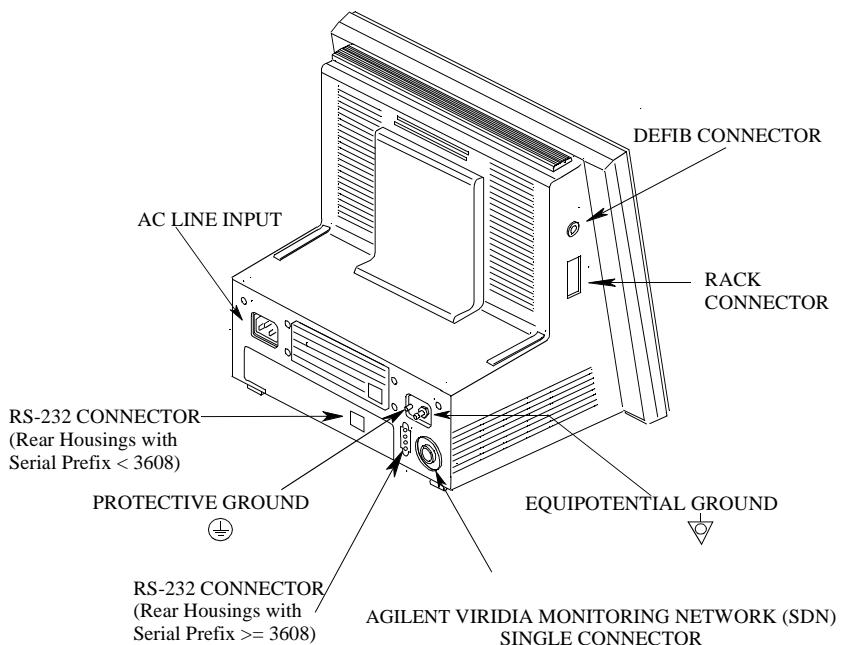
The Battery Charged and the Battery Charging LEDs work together to display the status of the battery charging sequence. The following table describes the sequence.

**Table 1-2. LED Pattern During Charge Sequence**

Residual Capacity	Charging LED	Charged LED
Up to 40%	Flashing	Off
More than 40%, Less than 90%	Steady	Off
More than 90%	Off	Steady

## Interfaces

There are two different types of interfaces available. One is the Agilent patient care system interface which comes standard with most Agilent V24/V26 Models. The second type of interface, the RS-232 interface, is optional and permits MECIF connectivity for data transfer to other computers and connection to the Agilent Anesthesia Gas Module. Alternatively, the RS-232 option can be used to provide local printing capability. Figure 1-10 “Interface Connections on Rear Housing(s)” shows the location of Agilent monitoring network (SDN) and RS-232 interface connections on the two types of currently supported rear housings; rear housings with a prefix serial code < 3608 and rear housings with a prefix serial code >= 3608.



**Figure 1-10. Interface Connections on Rear Housing(s)**

Both types of interfaces are discussed below.

*What is the Agilent patient care system?*

*Agilent patient care system, also known as Agilent monitoring network (SDN), is a local area communications network designed to share patient data among bedside instruments, Central Stations, recorders, printers, computer systems, and other information systems connected to the Agilent monitoring network (SDN).*

*The Agilent monitoring network (SDN) is a digital communications network that allows real-time transfer of digitized patient data between these instruments. The communications protocol, data formatting and hardware implementation accommodates a variety of communications needs for present and future expansion.*

## **Agilent Patient Care System Interface**

When connected to the Agilent patient care system network, or Agilent monitoring network (SDN), the Agilent V24/V26 Series is capable of receiving and displaying current vital signs, waves and alarms from other bedsides on the network. The Agilent monitoring network (SDN) connection also allows connectivity to a Central Station and centralized arrhythmia systems. The instrument has one Agilent monitoring network (SDN) connector (upstream only); therefore it must be the last instrument on an Agilent monitoring network (SDN) branch.

The Agilent monitoring network (SDN) interface subsystem consists of the physical connection to the Agilent monitoring network (SDN) network and controlling firmware resident on the System Board. (Your configuration may use an Agilent monitoring network (SDN) daughter card. Refer to *Appendix A* for more information.) When the Agilent V24/V26 Series is connected to the Agilent monitoring network (SDN), digitized patient information is transmitted serially at regular intervals (called poll cycles) over branch cables to the System Communications Controller (SCC). The SCC sequentially receives, synchronizes and rebroadcasts the digitized patient information to all the instruments connected to the Agilent monitoring network (SDN). Patient data is received for use by each instrument by way of the Agilent monitoring network (SDN) interface circuitry resident in each instrument.

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### **Warning:**

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**Connecting the Agilent monitoring network (SDN) cable when the product is powered on is not supported. Error codes and Agilent monitoring network (SDN) interface lock-up may occur. Power cycling the product will recover the product. No permanent damage will result. To prevent unintentional disruption in monitoring, be sure the SDN interface cable is properly secured at both ends when connecting to the Agilent monitoring network (SDN).**

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## **RS-232 Network**

The optional RS-232 interface has one port that permits either MECIF connectivity, M1026A AGM compatibility, connection to a personal computer, or local printing capability.

## **Patient Data Management**

The Agilent V24/V26 Series provides Patient Data Management software, allowing you to:

- manage patient information
- view patient data in graphs or tables
- print patient information reports via an Agilent central station or local RS-232 printer.

## Specifications

### Functionality and Option Sets

For an overview of the functionality and options for each bundle in Releases A.0, B.0 and C.0, please refer to Table “Release C.0 Functionality and Options,” on page 2-46 and Table “Release A.0/B.0 Functionality and Options,” on page 2-47.

### Dimension and Weight

The following table lists the dimensions and weight for both the 8-slot and 6-slot racks.

Table 1-3. Rack Dimensions and Weight		
Configuration	Dimensions (HxWxD)	Weight
Mainframe without plug-in rack	<b>Models V24, V24C, V26C</b> 28.0 x 32.0 x 25.0 cm (11.0 x 12.6 x 10.2 in) <b>Models V24CT, V26CT</b> 28.0 x 32.0 x 26.0 cm (11.0 x 12.6 x 10.4 in)	<b>Models V24, V24C, V26C</b> 5.1 kg (11.3 lbs) <b>Models V24CT, V26CT</b> 6.7 kg without batteries (14.8 lbs) 7.7 kg with batteries (16.9 lbs)
8 slot rack without modules	13.7 x 32.9 x 8.9 cm (5.4 x 12.9 x 3.5 in)	1.1 kg (2.4 lbs)
8 slot rack with modules	13.7 x 32.9 x 13.0 cm (5.4 x 12.9 x 5.1 in)	varies per configuration
6 slot rack without modules	14.9 x 29.6 x 11.0 cm (5.9 x 11.6 x 4.3 in)	1.1 kg (2.4 lbs)
6 slot rack with modules	14.9 x 29.6 x 15.0 cm (5.9 x 11.6 x 5.9 in)	varies per configuration
Parameter Modules	Refer to relevant <i>Technical Data Sheet</i> .	

## Environmental

### Temperature Range

**Operating:** Models V24, V24C, V26C +5 to 40°C (41 to 104°F)  
Models V24CT, V26CT +5 to 35°C (41 to 95°F)

**Storage:** Models V24, V24C, V26C -20 to 60°C (4 to 140°F)  
Models V24CT, V26CT -15 to 40°C (5 to 104°F)

### Humidity Range

**Operating:** Models V24, V24C, V26C 95% RH max @ 40°C (104°F) (Non-condensing)  
Models V24CT, V26CT 95% RH max @ 35°C (95°F) (Non-condensing)

**Storage:** 90% RH max @ 60°C (140°F)

### Altitude Range

**Operating:** Up to 4,600 m (15,000 ft)

**Storage:** Up to 4,600 m (15,000 ft)

## Safety

Comply with UL2601, IEC 601-1, CSA C22.2 no. 601-1, EN60601-1, and EN60601-1-2 and carries the CE mark to the Medical Device Directive in Europe.

## AC Input

90 to 250 Vac, 48 to 66 Hz, nominal

**Max. power consumption:** 150 Volt-Amperes

## Patient Data Management

### Continuously Acquired Data

**Maximum no. of parameters:** 16

**Sample Interval:** 12 seconds, or 1 minute average (average of five 12-second intervals).

**Maximum no. of values for each parameter:** 1441.

**Storage:** up to 24 hours.

### Aperiodically Acquired Data

**Maximum no. of parameters:** 76

**Maximum no. of values for each parameter:** 48/96 (bundle specific).

**Storage:** up to 24 hours.

### Tabular Trends (Vital Signs)

**Time columns per screen:** 8.

**Parameter rows per screen:** up to 13.

**Column interval:** 1 minute to 3 hours.

### Graphic Trends

**Graphs per screen:** up to 3 parameters.

**Data resolution:** 12 seconds or 1 minute average.

**Duration:** 1, 2, 8, 16, 24 hours (1 minute resolution). 1 or 4 hours (12 second resolution).

**Resolution:** up to 450 data points along the X-axis.

## Display

**Monochrome Display:** In Release B.0: white-on-black presentation using monochrome backlit Flat Panel display. Previous releases support black-on-white presentation as well as white-on-black.

**Display size:** 24.13 cm (9.5 in diagonal measure)

**Color Display:** Flat panel color display

**Display size:** 26 cm (10.4 in diagonal measure)

**The remaining Display-related specifications pertain to all models.**

**Display Resolution:** 640 x 480 Pixels

**Waveform Length:** 12.95 cm (5.1 in) [5.2 sec@ 25mm/sec]

**Waveform Height:** 2.8 cm (1.1 in) [4-channel]

**Normal Character Size:** 3 x 5.3 mm (.12 x .21 in)

## Parameter Modules

See Table 1-5, “Release C.0 Functionality and Options,” on page 1-46 and Table 1-6, “Release A.0/B.0 Functionality and Options,” on page 1-47 for the types of parameter modules that can be used with the V24/V26 Series.

Refer to the relevant *Technical Data Sheet* for Agilent parameter module specifications.

## Plug-in Satellite Racks

The following table gives the Satellite Rack specifications.

**Table 1-4. Plug-in Satellite Rack Specifications**

Plug-in Satellite Rack	Maximum no. of modules	Maximum Plug-in Racks	Cable length
M1041A (standard)	8 single-width modules	one	4 m (13.1 ft)
M1276A (optional)	6 single-width modules	one	4 m (13.1 ft)

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## Mounting Options

For information on mounting options please refer to Agilent’s mounting website <http://www.healthcare.agilent.com/mpgpmd/vmount> and to the Installation Notes shipped with the mounting devices.

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## Practice Exercise

To check your understanding, please answer the following questions. After completing this exercise, check your answers to those provided at the end of this chapter.

1. Why should the Agilent V24/V26 Series be the last instrument on an Agilent monitoring network (SDN) branch?

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2. The instruments' displays do NOT show \_\_\_\_\_.
  - a. 6 minutes of OxyCRG
  - b. 4 Waves
  - c. 8 Waves
  - d. Overview
  - e. ST segment analysis
3. The instruments will present \_\_\_\_\_ when networked to an Agilent arrhythmia monitoring system.
  - a. arrhythmia status messages only
  - b. arrhythmia status messages and delayed annotated waveform only
  - c. arrhythmia status messages, delayed annotated waveform, and arrhythmia data management
4. Which function does the System Board include?
  - a. Process keystrokes from the front panel keypad.
  - b. Acquire and process physiological data from the plug-in parameter modules.
  - c. Create tones for audible alarms.
  - d. Controls the interface to the Flat Panel display.
  - e. Controls the interface to the Agilent Patient Care System Network.
  - f. Controls the RS-232 interface
  - g. All of the above

5. What is the display resolution of the instruments?
  - a. 460 x 280 Pixels
  - b. 640 x 480 Pixels
  - c. 820 x 480 Pixels
  - d. 1020 x 640 Pixels
  - e. none of the above
6. What parameter module(s) are NOT compatible with the instruments?
  - a. SvO<sub>2</sub>
  - b. ssCO<sub>2</sub>
  - c. Data Transfer
  - d. FiO<sub>2</sub>
  - e. SpO<sub>2</sub>/PLETH
  - f. I-STAT
  - g. EEG
7. The Agilent V24/V26 Series has an RS-232 interface.
  - a. true
  - b. false
  - c. optional
8. Which key allows you to change or adjust parameter settings?
  - a. Monitor Setup
  - b. Module Setup
  - c. Procedures
  - d. Trends
  - e. Main Screen

## **Practice Exercise Answers**

- 1** The instruments only have one upstream Agilent monitoring network (SDN) connector.
- 2** c. 8 Waves
- 3** c. Arrhythmia status messages, delayed annotated waveform, and arrhythmia data management
- 4** g. All of the listed functions.
- 5** b. 640 x 480 Pixels
- 6** a. SvO<sub>2</sub>  
d. FiO<sub>2</sub>  
g. EEG
- 7** c. optional
- 8** b. Module Setup



## Chapter 2 Testing & Maintaining the Agilent V24/V26 Series

The first section in this chapter, “Test and Inspection Requirements”, describes the procedures required to ensure that the Agilent V24/V26 Series monitor is in safe working order. The following sections describe recommended procedures for maintaining the equipment. These procedures apply to all versions of the Agilent V24/V26 Series except as stated.

The procedures are grouped as follows:

- Test and Inspection Requirements — safety tests and periodic preventive maintenance
- Performing General Inspections of the System
- Cleaning Procedures
- Performing Accuracy and Calibration Procedures

---

### Objectives

In order to meet the chapter’s goals, you should be able to:

- Perform required safety checks and maintenance procedures.
- Perform a general inspection of the system.
- Clean the major units of the system.

---

### Concepts

The V24/V26 Series has different levels of preventive maintenance and checks that should be performed on a periodic basis or as recommended.

The procedures described in this chapter should be performed at the specified time intervals to ensure effective preventive maintenance. The checklist may be photocopied, completed by the maintainer, and filed for reference.

## Maintenance Checklist

Check Here	Topics in this Chapter	See Page
<b>Test and Inspection Requirements</b>		
	When to Perform Test Blocks	2-3
	Power On and Performance Tests	2-5
	Safety Tests	2-11
<b>General Inspections of the System</b>		
	Inspect the System Hardware	2-15
	Inspect the Cables and Cords	2-15
	Inspect the LEDs of the System	2-16
	Inspect the Flat Panel Display	2-16
	Inspect the Controls of the System	2-17
<b>Performance Assurance Test</b>		
	Performance Assurance Test	2-18
<b>Preventive Maintenance</b>		
	Replacement of Backlight Tube Assembly	2-19
	Battery Care and Handling	2-19
	Cleaning and Disinfecting Procedures	2-23
	General Cleaning of the System	2-24
	General Disinfecting of the System	2-25
	Cleaning the Recorder Module	2-26
	Cleaning the Blood Analysis Module	2-30
<b>Upgrade and Cloning Instructions</b>		
	Parts Checklist	2-31
	Connecting the Flash Programming Tool	2-34
	Upgrading the Utility CPU Software	2-36
	Upgrading the Application CPU Software	2-39
	Performing an EEPROM Upgrade	2-41
	EEPROM Number Tables	2-43
	Performing EEPROM Cloning	2-50
	EEPROM Upgrades Between Application Bundles	2-52

## Test and Inspection Requirements

This section is intended primarily for Agilent customer engineers and lists the test requirements for servicing, installation and preventive maintenance. For some tests it is required that the Agilent engineer documents the results in a service record.

Table 1-1 “When to Perform Test Blocks” explains when to perform the procedures. Table 1-2 “Test and Inspection Requirements” explains the procedures to be performed. Table 1-3 “Test and Inspection Requirements – Safety” explains the procedures to be performed and gives full details of the Safety Tests.

**Note:** Only Agilent service engineers are required to report the results of the following safety and performance tests back to the factory. Of the performance tests, only those for NBP and Sidestream CO<sub>2</sub> need to be reported.

**Table 1-1 When to Perform Test Blocks**

Service Event – When to Perform	Test Block(s) Required Complete these tests
Installation of M1205A with NO System (SDN) or with Medical equipment connections (ex. AGM or Vuemail)	Perform Visual and Power On test blocks (see page 2-5).
Installation of M1205A that is connected to a System (SDN)	Perform Visual and Power On test blocks. If the 78581A safety test (see the 78581A service manual) has passed previously no further safety tests are required. If the 78581A safety test has not been performed, it must be completed.
Installation of monitor that has RS232 connections to non-medical devices (for example, Laser Printer or PC)	Perform Visual and Power On test blocks (see page 2-5). Perform Safety (1) test block (see page 2-11).
Repairs where the power supply or rear housing assembly is replaced	Perform Power On and Safety (2) test blocks (see page 2-11).
Repairs where the monitor has been dropped	Perform Power On and Safety (2) and (3) test blocks (see page 2-12).
All other M1205A repairs, Hardware or Software Upgrades	Perform Power On test block.
Preventive Maintenance <sup>1</sup>	Perform the NBP and Sidestream CO <sub>2</sub> Module Performance test blocks <b>every year</b> (see page 2-6). For the BIS module no periodic preventive maintenance is required.
Performance Assurance and Safety Tests <sup>2</sup>	Perform all other Performance and Safety test blocks (1), (2) and (3) once every two years.

1. For Germany only: For modules that do not have the CE mark, contact the Customer Response Center in Ratingen for information.
2. For the BIS module performance and safety testing is optional (Agilent recommends yearly testing). However, safety testing (Safety test block (3)) is required if there is suspected liquid ingress or after everytime the case of any of the BIS components has been opened.

**WARNING**

**Use only the power cord supplied with the instrument. Use only a three-wire receptacle that is properly grounded.**

**When connecting a non-medical device such as a printer to the RS-232 Interface of Model V24CT/V26CT, the monitor must be properly grounded and the non-medical device may not have a chassis leakage current above 500 µA (300 µA in the US). If the leakage current is higher, the non-medical device must be powered from a separation transformer. These precautions must be taken in order to prevent the possibility of an electrical shock hazard (to the user and or patient) from excessive ground leakage currents from the non-medical device such as a printer, and to maintain compliance with IEC 60601-1-1 where applicable. This hazard is especially prevalent when the Model V24CT/V26CT is operated in battery mode.**

**In normal AC line operation, grounding the monitor is accomplished by ensuring that the AC line cord is connected from the monitor to a properly grounded AC receptacle. Alternatively and additionally, proper grounding may be achieved by attaching a safety grounded wire to the threaded safety ground stud  found on the rear of the monitor.**

**Isolation may be achieved by powering the printer through a safety isolation transformer.**

**The Plug-in Module Rack must always be mounted in a horizontal position. Improper mounting of the Plug-in Module Rack may cause the rack to fall from the wall mount or roll stand causing a patient or user safety concern.**

**The Configuration Mode does not support patient monitoring: when the instrument is attached to a patient, it must be in Monitoring Mode.**

## Power On and Performance Tests

**Table 1-2 Test and Inspection Requirements**

Test Block Name	Test or "Inspection" to Perform			Expected Test Results	What to Record on Service Record																										
<b>Visual Test</b>	Inspect the system for obvious signs of damage. Also check external leads and accessories.			The system does not have any obvious signs of damage = Pass.	V:P or V:F where P = Pass and F = Fail																										
<b>Power On Test</b>	<table border="1"> <thead> <tr> <th>Step</th><th>Action</th></tr> </thead> <tbody> <tr> <td>1</td><td>Switch on the monitor.</td></tr> <tr> <td>2</td><td>Plug in an ECG Module.</td></tr> <tr> <td>3</td><td>Observe whether the monitor boots up successfully without displaying an error code and if an ECG wave appears on the display.</td></tr> </tbody> </table>			Step	Action	1	Switch on the monitor.	2	Plug in an ECG Module.	3	Observe whether the monitor boots up successfully without displaying an error code and if an ECG wave appears on the display.	Monitor boots up displaying no error codes and displays an ECG wave = Pass	PO:P or PO:F where P = Pass and F = Fail																		
Step	Action																														
1	Switch on the monitor.																														
2	Plug in an ECG Module.																														
3	Observe whether the monitor boots up successfully without displaying an error code and if an ECG wave appears on the display.																														
<b>Power On Test for Model V24CT/V26CT</b>	<table border="1"> <thead> <tr> <th>Step</th><th>Action</th></tr> </thead> <tbody> <tr> <td>1</td><td>Switch on the monitor.</td></tr> <tr> <td>2</td><td>Plug in an ECG Module.</td></tr> <tr> <td>3</td><td>Observe whether the monitor boots up successfully without displaying an error code and if an ECG wave appears on the display. If monitor boots up with no error codes and displays an ECG wave continue to next step.</td></tr> <tr> <td>4</td><td>Check lower right of the display for the battery symbols indicating both batteries are installed. If battery symbols are present continue to next step.</td></tr> <tr> <td>5</td><td>With the monitor connected to AC power and the AC Power LED on, Check whether the Battery Charging and Battery Charged LED's on the front panel are indicating one of the following conditions:  <table border="1"> <thead> <tr> <th>Battery Charging</th><th>Battery Charged</th><th>Charge Status</th></tr> </thead> <tbody> <tr> <td>Flashing</td><td>Off</td><td>&lt;40%</td></tr> <tr> <td>On</td><td>Off</td><td>40%-90%</td></tr> <tr> <td>Off</td><td>On</td><td>&gt;90%</td></tr> </tbody> </table> </td></tr> <tr> <td>6</td><td>Disconnect Monitor from AC power. Monitor should operate if either battery is removed. Remove the batteries one at a time and check that monitor continues to operate.</td></tr> </tbody> </table>			Step	Action	1	Switch on the monitor.	2	Plug in an ECG Module.	3	Observe whether the monitor boots up successfully without displaying an error code and if an ECG wave appears on the display. If monitor boots up with no error codes and displays an ECG wave continue to next step.	4	Check lower right of the display for the battery symbols indicating both batteries are installed. If battery symbols are present continue to next step.	5	With the monitor connected to AC power and the AC Power LED on, Check whether the Battery Charging and Battery Charged LED's on the front panel are indicating one of the following conditions: <table border="1"> <thead> <tr> <th>Battery Charging</th><th>Battery Charged</th><th>Charge Status</th></tr> </thead> <tbody> <tr> <td>Flashing</td><td>Off</td><td>&lt;40%</td></tr> <tr> <td>On</td><td>Off</td><td>40%-90%</td></tr> <tr> <td>Off</td><td>On</td><td>&gt;90%</td></tr> </tbody> </table>	Battery Charging	Battery Charged	Charge Status	Flashing	Off	<40%	On	Off	40%-90%	Off	On	>90%	6	Disconnect Monitor from AC power. Monitor should operate if either battery is removed. Remove the batteries one at a time and check that monitor continues to operate.	If the monitor operates with either Battery 1 or Battery 2 removed Power On Test has passed.	PO:P or PO:F where P = Pass and F = Fail
Step	Action																														
1	Switch on the monitor.																														
2	Plug in an ECG Module.																														
3	Observe whether the monitor boots up successfully without displaying an error code and if an ECG wave appears on the display. If monitor boots up with no error codes and displays an ECG wave continue to next step.																														
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Table 1-2 Test and Inspection Requirements

Test Block Name	Test or "Inspection" to Perform	Expected Test Results	What to Record on Service Record																		
<u>Performance Test NBP Module</u>	<b>Accuracy Test</b> <table border="1"> <thead> <tr> <th>Step</th><th>Action</th></tr> </thead> <tbody> <tr> <td>1</td><td>Connect the manometer and the pump with tubing and expansion chamber to the NBP connector on the NBP Module.</td></tr> <tr> <td>2</td><td>Go to Service Mode.</td></tr> <tr> <td>3</td><td>Press the <b>NBP</b> button on the NBP Module.</td></tr> <tr> <td>4</td><td>Press <b>Start</b> button in the task window to close valves.</td></tr> <tr> <td>5</td><td>Raise the pressure to 280 mmHg with the manometer pump.</td></tr> <tr> <td>6</td><td>Wait 10 sec. for the measurement to stabilize.</td></tr> <tr> <td>7</td><td>Compare the manometer values with the displayed values.</td></tr> <tr> <td>8</td><td>Document the value displayed by the Monitor. If the difference is greater than 3 mmHg, calibrate the module.</td></tr> </tbody> </table>	Step	Action	1	Connect the manometer and the pump with tubing and expansion chamber to the NBP connector on the NBP Module.	2	Go to Service Mode.	3	Press the <b>NBP</b> button on the NBP Module.	4	Press <b>Start</b> button in the task window to close valves.	5	Raise the pressure to 280 mmHg with the manometer pump.	6	Wait 10 sec. for the measurement to stabilize.	7	Compare the manometer values with the displayed values.	8	Document the value displayed by the Monitor. If the difference is greater than 3 mmHg, calibrate the module.	Value displayed on Monitor = x1  If difference (<= 3mm)  Proceed to next test.	
Step	Action																				
1	Connect the manometer and the pump with tubing and expansion chamber to the NBP connector on the NBP Module.																				
2	Go to Service Mode.																				
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7	Compare the manometer values with the displayed values.																				
8	Document the value displayed by the Monitor. If the difference is greater than 3 mmHg, calibrate the module.																				
<u>Performance Test NBP Module (contd.)</u>	<b>Leakage Test</b> <table border="1"> <thead> <tr> <th>Step</th><th>Action</th></tr> </thead> <tbody> <tr> <td>1</td><td>Press the <b>NBP</b> button on the Module.</td></tr> <tr> <td>2</td><td>Press the <b>Start</b> softkey in the task window.</td></tr> <tr> <td>3</td><td>Pressurize the gauge to 280 mmHg.</td></tr> <tr> <td>4</td><td>Watch the pressure value for 60 seconds. After 60 seconds the value should have decreased by less than 6 mmHg.</td></tr> <tr> <td>5</td><td>Calculate and document: Leakage test = Accuracy – displayed value</td></tr> </tbody> </table>	Step	Action	1	Press the <b>NBP</b> button on the Module.	2	Press the <b>Start</b> softkey in the task window.	3	Pressurize the gauge to 280 mmHg.	4	Watch the pressure value for 60 seconds. After 60 seconds the value should have decreased by less than 6 mmHg.	5	Calculate and document: Leakage test = Accuracy – displayed value	Leakage test value = x2 (<= 6 mmHg)  Proceed to next test.							
Step	Action																				
1	Press the <b>NBP</b> button on the Module.																				
2	Press the <b>Start</b> softkey in the task window.																				
3	Pressurize the gauge to 280 mmHg.																				
4	Watch the pressure value for 60 seconds. After 60 seconds the value should have decreased by less than 6 mmHg.																				
5	Calculate and document: Leakage test = Accuracy – displayed value																				

Table 1-2 Test and Inspection Requirements

Test Block Name	Test or "Inspection" to Perform	Expected Test Results	What to Record on Service Record																		
	<b>Linearity Test</b> <table border="1"> <thead> <tr> <th>Step</th><th>Action</th></tr> </thead> <tbody> <tr> <td>1</td><td>Reduce the manometer pressure down to 150 mmHg.</td></tr> <tr> <td>2</td><td>Wait 10 sec. for the measurement to stabilize.</td></tr> <tr> <td>3</td><td>Compare the manometer values with the displayed values.</td></tr> <tr> <td>4</td><td>Document the value displayed by the Monitor. If the difference is greater than 3 mmHg then calibrate the module.</td></tr> </tbody> </table> <b>Valve Test</b> <table border="1"> <thead> <tr> <th>Step</th><th>Action</th></tr> </thead> <tbody> <tr> <td>1</td><td>Raise the pressure to 280 mmHg.</td></tr> <tr> <td>2</td><td>Press <b>Stop</b> on the module to open valves.</td></tr> <tr> <td>3</td><td>Wait 5 seconds then document the value.</td></tr> </tbody> </table>	Step	Action	1	Reduce the manometer pressure down to 150 mmHg.	2	Wait 10 sec. for the measurement to stabilize.	3	Compare the manometer values with the displayed values.	4	Document the value displayed by the Monitor. If the difference is greater than 3 mmHg then calibrate the module.	Step	Action	1	Raise the pressure to 280 mmHg.	2	Press <b>Stop</b> on the module to open valves.	3	Wait 5 seconds then document the value.	Value displayed on Monitor = x3 If difference (<= 3 mmHg)  Proceed to next test	
Step	Action																				
1	Reduce the manometer pressure down to 150 mmHg.																				
2	Wait 10 sec. for the measurement to stabilize.																				
3	Compare the manometer values with the displayed values.																				
4	Document the value displayed by the Monitor. If the difference is greater than 3 mmHg then calibrate the module.																				
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2	Press <b>Stop</b> on the module to open valves.																				
3	Wait 5 seconds then document the value.																				
<b>Performance Test Sidestream CO<sub>2</sub></b>	<b>Flow Adjustment Procedure</b> <table border="1"> <thead> <tr> <th>Step</th><th>Action</th></tr> </thead> <tbody> <tr> <td>1</td><td>Enter the CO<sub>2</sub> Sidestream Task Window by pressing <b>Parameters</b> followed by <b>CO<sub>2</sub> Sidestream</b>.</td></tr> <tr> <td>2</td><td>Press <b>Start Pump</b>. The date and time of the last flow adjustment are displayed.</td></tr> <tr> <td>3</td><td>Start the Flow Adjustment procedure by connecting the flow meter and pressing <b>Start Pump</b>. After about 5 seconds, the flow in ml/min displays in the Task Window.</td></tr> <tr> <td>4</td><td>Use the <b>Adjust Flow</b> to adjust the value displayed in the Task Window to the value displayed by the external flow meter.</td></tr> <tr> <td>5</td><td>Write down the value displayed by the monitor (<b>x1</b>).</td></tr> <tr> <td>6</td><td>Press <b>Confirm</b> to store the readjusted flow rate value. After about 5 seconds, the message "Adjustment done" displays. The flow is automatically set to 100 ml/min.</td></tr> <tr> <td>7</td><td>If the displayed value is not 100 ml/min, repeat Steps 3 through 5.</td></tr> </tbody> </table>	Step	Action	1	Enter the CO <sub>2</sub> Sidestream Task Window by pressing <b>Parameters</b> followed by <b>CO<sub>2</sub> Sidestream</b> .	2	Press <b>Start Pump</b> . The date and time of the last flow adjustment are displayed.	3	Start the Flow Adjustment procedure by connecting the flow meter and pressing <b>Start Pump</b> . After about 5 seconds, the flow in ml/min displays in the Task Window.	4	Use the <b>Adjust Flow</b> to adjust the value displayed in the Task Window to the value displayed by the external flow meter.	5	Write down the value displayed by the monitor ( <b>x1</b> ).	6	Press <b>Confirm</b> to store the readjusted flow rate value. After about 5 seconds, the message "Adjustment done" displays. The flow is automatically set to 100 ml/min.	7	If the displayed value is not 100 ml/min, repeat Steps 3 through 5.	Value displayed on monitor = x1 (where x1 = 100 +/- 10 ml/min)  Proceed to next test			
Step	Action																				
1	Enter the CO <sub>2</sub> Sidestream Task Window by pressing <b>Parameters</b> followed by <b>CO<sub>2</sub> Sidestream</b> .																				
2	Press <b>Start Pump</b> . The date and time of the last flow adjustment are displayed.																				
3	Start the Flow Adjustment procedure by connecting the flow meter and pressing <b>Start Pump</b> . After about 5 seconds, the flow in ml/min displays in the Task Window.																				
4	Use the <b>Adjust Flow</b> to adjust the value displayed in the Task Window to the value displayed by the external flow meter.																				
5	Write down the value displayed by the monitor ( <b>x1</b> ).																				
6	Press <b>Confirm</b> to store the readjusted flow rate value. After about 5 seconds, the message "Adjustment done" displays. The flow is automatically set to 100 ml/min.																				
7	If the displayed value is not 100 ml/min, repeat Steps 3 through 5.																				

Table 1-2 Test and Inspection Requirements

Test Block Name	Test or "Inspection" to Perform		Expected Test Results	What to Record on Service Record												
<b>Performance Test Sidestream CO<sub>2</sub> (contd.)</b>	<b>Barometric Pressure Adjustment Procedure</b>		Difference = x2 (<= 4 mmHg)	PSC:P/x1/x2 or PSC:F/x1/x2 where P = Pass and F = Fail												
	<table border="1"> <thead> <tr> <th>Step</th><th>Action</th></tr> </thead> <tbody> <tr> <td>1</td><td>Press <b>Barometer Pressure</b> to adjust the Barometric Pressure value. The Task Window displays the stored barometric pressure in mmHg.</td></tr> <tr> <td>2</td><td>If the displayed value is incorrect, use the <b>Barometer Pressure</b> key to adjust the value to atmospheric pressure.</td></tr> <tr> <td>3</td><td>Document the Difference (x2) between the actual atmospheric pressure and the value displayed by the monitor.</td></tr> <tr> <td>4</td><td>Press <b>Confirm</b> to store the displayed or adjusted value. After about 5 seconds, the message "Adjustment done" displays. The barometric pressure is then set to the value you entered.</td></tr> <tr> <td>5</td><td>Press <b>Main Screen</b> (or <b>Standard Display</b>) to return to the standard display in Service mode</td></tr> </tbody> </table>		Step	Action	1	Press <b>Barometer Pressure</b> to adjust the Barometric Pressure value. The Task Window displays the stored barometric pressure in mmHg.	2	If the displayed value is incorrect, use the <b>Barometer Pressure</b> key to adjust the value to atmospheric pressure.	3	Document the Difference (x2) between the actual atmospheric pressure and the value displayed by the monitor.	4	Press <b>Confirm</b> to store the displayed or adjusted value. After about 5 seconds, the message "Adjustment done" displays. The barometric pressure is then set to the value you entered.	5	Press <b>Main Screen</b> (or <b>Standard Display</b> ) to return to the standard display in Service mode		
Step	Action															
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2	If the displayed value is incorrect, use the <b>Barometer Pressure</b> key to adjust the value to atmospheric pressure.															
3	Document the Difference (x2) between the actual atmospheric pressure and the value displayed by the monitor.															
4	Press <b>Confirm</b> to store the displayed or adjusted value. After about 5 seconds, the message "Adjustment done" displays. The barometric pressure is then set to the value you entered.															
5	Press <b>Main Screen</b> (or <b>Standard Display</b> ) to return to the standard display in Service mode															
<b>Performance Test ECG</b>	<b>Step 1</b> Connect the patient simulator to the ECG Parameter Module using the Patient cable. <b>Step 2</b> Configure the Patient simulator as follows: ECG sinus rhythm HR = 100 BPM (Amplitude 1 mV) <b>Step 3</b> Check displayed ECG wave and HR value against the simulator configuration.		HR = 120 +/- 2 BPM	<b>These results do not have to be reported.</b>												
<b>Performance Test Respiration</b>	<b>Step 1</b> Connect the patient simulator to the ECG/ Resp Module using the patient cable. <b>Step 2</b> Configure the patient simulator as follows: Base impedance line 1500 Ohm Delta impedance 0.5 Ohm Respiration Rate 40/min <b>Step 3</b> Check displayed respiration rate against the simulator configuration.		RPM = 40 +/- 2 /min	<b>These results do not have to be reported.</b>												

Table 1-2 Test and Inspection Requirements

Test Block Name	Test or "Inspection" to Perform	Expected Test Results	What to Record on Service Record
<b>Performance Test Cardiac Output</b>	<p><b>Step 1</b> Connect the patient simulator to the C.O. Module using the patient cable.</p> <p><b>Step 2</b> Configure the Patient simulator as follows: Injection temperature: 2 °C Computation Const: 0.543 (Edward's Catheter) Flow 5 l/min</p> <p><b>Step 3</b> Check displayed value against the simulator configuration.</p>	C.O. = 5 +/- 1 l/min.	<b>These results do not have to be reported.</b>
<b>Performance Test Cardiac Output (contd.)</b> <b>Service Tool procedure</b>	<p><i>Note: This procedure applies for both Service Tools M1012-14232C and M1012-61601.</i></p> <p><b>Step 1</b> Make sure to be in Monitoring Mode. Connect C.O. Interface Cable to module.</p> <p><b>Step 2</b> Connect one side of the Service Tool to Injectate receptacle of C.O. Interface Cable and the other side to Catheter Cable receptacle.</p> <p><b>Step 3</b> Enter Measure C.O. Task Window and check results.</p>	Tblood = 37.0°C +/- 0.1°C Tinj = 0.0°C +/- 0.1°C	<b>These results do not have to be reported.</b>
<b>Performance Test Invasive Pressure</b>	<p><b>Step 1</b> Connect the patient simulator to the Pressure module.</p> <p><b>Step 2</b> Set patient simulator to 0 pressure.</p> <p><b>Step 3</b> Make a Zero Calibration with the module.</p> <p><b>Step 4</b> Configure the patient simulator for P(static) = 200 mmHg.</p> <p><b>Step 5</b> Wait for the display.</p> <p><b>Step 6</b> Check displayed value against the simulator configuration. If there is a difference, calibrate the module.</p> <p><b>Note:</b> If the Module was calibrated with a dedicated reusable catheter, check the calibration together with this catheter.</p>	P = 200 +/- 5 mmHg	<b>These results do not have to be reported.</b>
<b>Performance Test Temperature</b>	<p><b>Step 1</b> Connect the patient simulator to the temperature input.</p> <p><b>Step 2</b> Configure the patient simulator to 40 °C or alternatively 100 °F.</p> <p><b>Step 3</b> Check displayed value against the simulator configuration.</p>	+/- 0.2 °C or +/- 0.4 °F	<b>These results do not have to be reported.</b>
<b>Performance Test SpO<sub>2</sub></b>	<p><b>Step 1</b> Connect the sensor to the SpO<sub>2</sub> module.</p> <p><b>Step 2</b> Measure the SpO<sub>2</sub> value on your own finger (this assumes that you are healthy).</p> <p><b>Step 3</b> Check displayed value against the simulator configuration.</p>	Between 95 and 100%	<b>These results do not have to be reported.</b>

Table 1-2 Test and Inspection Requirements

Test Block Name	Test or "Inspection" to Perform	Expected Test Results	What to Record on Service Record
<b>Performance Test ECG-Sync</b>	<p><b>Step 1</b> Connect the patient simulator to the ECG input and the defibrillator to the monitor ECG-Sync output.</p> <p><b>Step 2</b> Configure the patient simulator as follows: ECG sinus rhythm HR = 100 BPM (Amplitude 1 mV)</p> <p><b>Step 3</b> Switch defibrillator to simulation mode.</p> <p><b>Step 4</b> Check that the marker pulse is displayed before the T-Wave begins.</p>	Marker pulse is displayed before T-Wave begins.	<b>These results do not have to be reported.</b>
<b>Performance Test BIS PIC/DSC Test</b>	<p><b>Step 1</b> In Monitoring mode connect the Sensor Simulator (for maximum usage please refer to the documentation delivered with the Sensor Simulator) to the Patient Interface Cable</p> <p><b>Step 2</b> Enter the BIS Task Window by pressing <b>Module Setup</b>, followed by <b>BIS</b>.</p> <p><b>Step 3</b> Start Impedance Check by pressing <b>Start Check</b>. This brings up the BIS Cyclic Check TaskWindow. Check the displayed results.</p>	Electrode 1: 4-6 kΩ Electrode 2: 8-12 kΩ Electrode 3: 1-3 kΩ	<b>These results do not have to be reported.</b>
<b>Performance Test BIS (continued) DSC Test</b>	<p><b>Step 1</b> Enter Service Mode</p> <p><b>Step 2</b> Enter the BIS Task Window by pressing <b>Module Setup</b>, followed by <b>BIS</b>.</p> <p><b>Step 3</b> StartTest by pressing <b>Test DSC</b>. Check the displayed results.</p>	Module: Test passed BIS engine: Test passed DSC: Test passed	<b>These results do not have to be reported.</b>

## Safety Tests

*For Europe and Asia-Pacific:*

according to IEC 601-1:1988+A1+1991+A2:1995 = EN60601-1:1990+A1:1991+A2:1995

*For the US:*

according to UL 2601-1

The test procedures outlined in this section are to be used **only** for verifying safe installation or service of the product in question.

The set-ups used for these tests and the acceptable ranges of values are derived from local and international standards but may not be equivalent.

These tests are **not a substitute for local safety testing** where it is required for an installation or a service event.

If using the Metron Safety tester, use your local regulation to perform the test, *for example*, in Europe IEC601-1/IEC601-1-1, and in the U.S. UL2601-1. The Metron Report should print results with the names listed below, along with other data.

The Safety Tests required to ensure that the V24/V26 Series is in safe working order are detailed in the following tables.

Table 1-3 Test and Inspection Requirements – Safety

Test Block Name	Test or "Inspection" to Perform	Expected Test Results	What to Record on Service Record
<b>Safety (1):</b>	<p>System Safety Test Enclosure Leakage Current / <b>Normal Condition:</b></p> <p>maximum leakage current = <b>x1</b>.  <b>x1</b> &lt;= 100 µA          IEC601-1, UL2601-1          (UL544 test not required)</p> <p>System Safety Test Enclosure Leakage Current / <b>Single Fault Condition</b></p> <p>maximum leakage current = <b>x2</b>.  <b>x2</b> is          &lt;= 500 µA (IEC601-1)          or          &lt;= 300 µA (UL2601-1)          or          &lt;= 100 µA (UL544)</p>	<p><b>Normal Condition</b></p> <p>maximum leakage current = <b>x1</b>.  <b>x1</b> &lt;= 100 µA          IEC601-1, UL2601-1          (UL544 test not required)</p> <p><b>Single Fault</b></p> <p>maximum leakage current = <b>x2</b>.  <b>x2</b> is          &lt;= 500 µA (IEC601-1)          or          &lt;= 300 µA (UL2601-1)          or          &lt;= 100 µA (UL544)</p>	<p><b>S1:P/x1/x2 or S1:F/x1/x2</b>          where P = Pass and F = Fail</p>
<b>Safety (2):</b>	Protective Earth	<p>With mains cable:          Maximum impedance = <b>x</b> &lt;= 100 mOhms          All authorities (IEC601-1, UL2601-1, UL544)</p>	<p><b>S2:P/x or S2:F/x</b>          where P = Pass and F = Fail</p>

**Table 1-3 Test and Inspection Requirements – Safety**

Test Block Name	Test or “Inspection” to Perform	Expected Test Results	What to Record on Service Record
<b>Safety (3):</b>	Patient Leakage Current AC	Maximum leakage current = x $\leq 50 \mu\text{A} @ 250\text{V}$ (IEC601-1 or UL2601-1) or $\leq 10 \mu\text{A} @ 120\text{V}$ without patient leads connected (UL544) or $\leq 20 \mu\text{A} @ 120\text{V}$ with patient leads connected (UL544)	<b>S3:P/x or S3:F/x</b>  where P = Pass and F = Fail

**Table 1-4 Safety Test Diagrams**

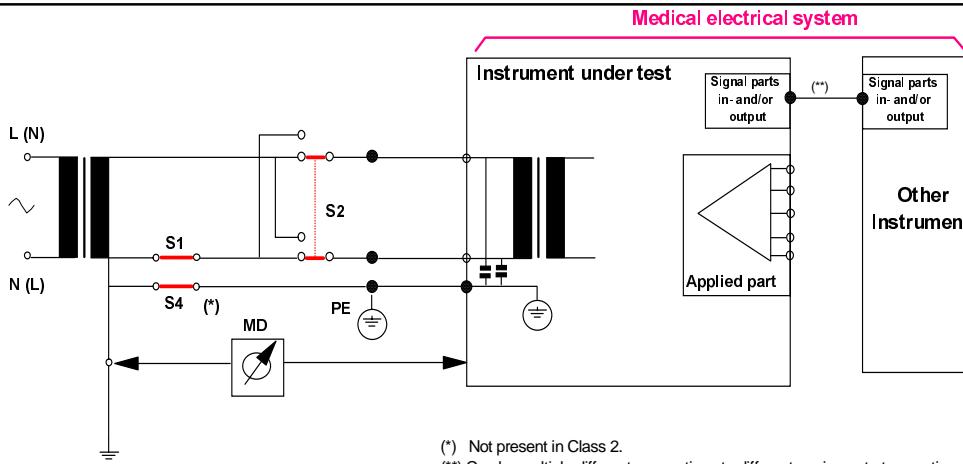
Test Block Name	Test or Inspection to Perform
Safety(1) System Enclosure Leakage Current – NC (normal condition)	 <p>Medical electrical system</p> <p>Instrument under test</p> <p>Other Instrument</p> <p>Applied part</p> <p>(*) Not present in Class 2.          (**) Can be multiple different connections to different equipment at same time.</p> <p>Measures leakage current of exposed metal parts of Instrument under Test (IUT) and between parts of the system within the <b>patient environment</b>; normal and reversed polarity using S2.</p> <p>Safety test according to IEC 601-1-1 (Clause 19.201.1). Report largest value.</p>

Table 1-4 Safety Test Diagrams

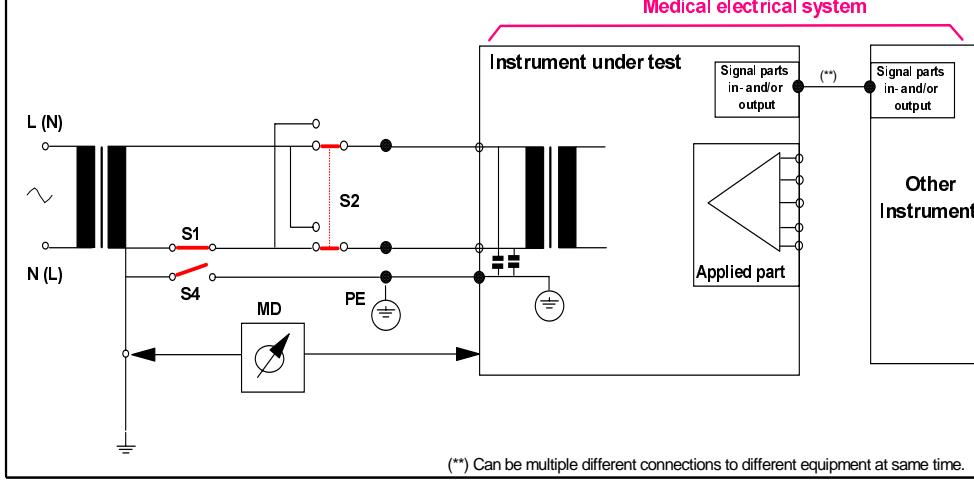
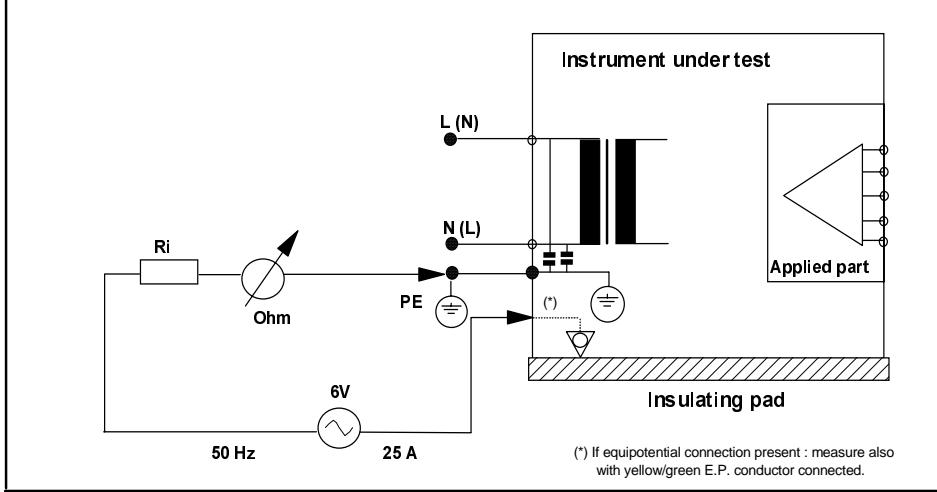
Test Block Name	Test or Inspection to Perform
Safety(1) System Enclosure Leakage Current – OE (open earth)	 <p>(***) Can be multiple different connections to different equipment at same time.</p> <p>Measures leakage current of exposed metal parts of IUT with Protective Earth (PE) open circuit (S4 = open) and between parts of the system within the <b>patient environment</b>; normal and reversed polarity using S2. <i>Safety test according to IEC 601-1-1 (clause based on 19.201.1).</i> Report largest value.</p>
Safety(2) Protective Earth	 <p>(*) If equipotential connection present : measure also with yellow/green E.P. conductor connected.</p> <p>Measures impedance of Protective Earth (PE) terminal to all exposed metal parts of IUT, which are for safety reasons connected to the Protective Earth (PE). Max. 100 mOhm. Test current 25 Amps applied for 5 to 10 seconds. The recommendation is to flex the main cable during the test in order to identify potential <b>bad</b> contact or damage of the earth wire. <i>Safety test according to IEC 601-1 (Clause 18).</i> Report largest value.</p>

Table 1-4 Safety Test Diagrams

Test Block Name	Test or Inspection to Perform
Safety(3) Patient Leakage Current – AC	<p>(*) Not present in Class 2</p> <p>Measures patient leakage current from Applied Part to earth caused by external main voltage on Applied Part with switch S5 open and closed. Each polarity combination possible is tested using S2 and S6. This test is applicable for every listed module (ECG, ECG/Resp, Invasive Pressure, NBP, Cardiac Output, CO<sub>2</sub>, SpO<sub>2</sub>, Temperature).</p> <p><i>Safety test according to IEC 601-1 (Clause 19.4.h). Report largest value.</i></p>

## General Inspections of the System

### Inspect the System Hardware

- Step 1** Examine the exterior of the unit for cleanliness and general physical condition. Ensure that plastic housings are intact, that all hardware is present and tight, and that there are no spilled liquids or other serious abuse.
- Step 2** Inspect connectors of the Rack for cleanliness and good condition. Ensure that the Modules are locked into place and do not slide out without first releasing the locking plate on the bottom of the Module.
- Step 3** Ensure all labeling is present and legible.
- Step 4** Inspect all accessories external to the system such as transducers, referring to the manufacturer's documentation.
- Step 5** Verify the backlight tube brightness is adequate. Replace the backlight tube if necessary. Agilent recommends replacement of the backlight tube every 18 months of continuous use.

### Inspect the Cables and Cords

- Step 1** Examine the line/power plug for damage. Ensure that the prongs of the plug do not move in the casing.
- Step 2** Inspect the line/power cord for signs of damage. If damaged, replace the entire cord. Ensure that any new line/power cord or plug is fitted with the same polarity as the old one.
- Step 3** Inspect the interconnecting cables between the module rack and the mainframe for general condition. Clean or replace contacts or housings are damaged, corroded or dirty. Examine them carefully to detect breaks in the insulation. Ensure that the cable connectors are properly engaged and that any connector screws are fully tightened.
- Step 4** Inspect the patient cables and leads and their strain reliefs for general condition. Examine cables carefully to detect breaks in the insulation and to ensure that they are gripped securely in the connectors of each end to prevent rotation or other strain.
- Step 5** Flex the patient cable near each end to verify that there are no intermittent faults.

## Inspect the LEDs of the System

The System Boot automatically starts every time the system is switched ON.

<b>TEST</b>	Turn the System On by pressing the power switch in the lower left-hand corner of the display.
<b>RESULT</b>	The system will click and light-up the LEDs on the keypad. After several seconds, the LEDs will go off and the display will start showing waveforms and numerics.  If the system fails to boot, see the Troubleshooting chapter in this manual

## Inspect the Flat Panel Display

Note the positions of the contrast/brightness controls before starting tests so that they are returned to their previous positions (assuming they are correct) at the end of the testing procedure.

- Step 1** Set up an ECG signal from a fixed rate simulator on the screen.
- Step 2** Check the ECG complexes. They should be regularly spaced. Uneven spacing indicates missing pixels. All portions of a simulated ECG waveform should be clear and visible, including the P wave and QRS.
- Step 3** Adjust the contrast control from maximum setting to minimum setting. Optimum contrast should be near the middle of the range.
- Step 4** Check to see if any noise (interference) is superimposed on the baseline with the ECG simulator attached. Baseline interference may be apparent as a thick baseline at high gain settings.
- Step 5** While in Diagnostic ECG Mode, apply an external 1 mV pulse. The trace should exhibit a leading edge with minimal rounding and a spike (or overshoot) of less than 10%. After 1 second, the pulse should have decayed no more than half of its original amplitude.
- Step 6** Return the shift, contrast and brightness controls to their previous positions (assuming they are correct). Refer to the Troubleshooting section if any problems were identified.

*The self-test ensures that the system is functioning correctly; it does not troubleshoot the system.*

## Inspect the Controls of the System

- Step 1** Examine all controls for physical condition. During the course of this examination, ensure that the controls perform their proper function
- Step 2** Check the module LEDs, see that they light up as expected.
- Step 3** Press the ECG key on the front of the ECG module in a system that is turned On. This brings up the ECG Task Window and verifies that the System PCB and integral rack are communicating with the plug-in module. If the ECG module does not respond, perform the module self-test.
- Step 4** Ensure correct operation (visually and audibly) of all Alarms using, if required, the User Guide and a Patient Simulator (Neurodyne Nevada Inc. Model 217A or med-Sim 300 or similar).
- Step 5** If possible connect the ECG parameter module of the unit to an ECG simulator and verify that an adequate trace is received at each patient lead selection.
- Step 6** Press **Monitor Setup**, **More Choices** and press **Monitor Revision**. In this screen, press **Show HW Rev**. This provides a real-time list of the modules in the rack. Remove a module and observe the list changes to delete the module you removed. Re-insert the module and observe the list changes to include the module.

## Performance Assurance Test

The following performance assurance test is designed to be completed to verify proper operation when:

- The monitor has been installed.
- An assembly has been replaced.
- To verify the operation any time the unit is suspect.

To verify your monitor works properly, perform the following procedure:

- Step 1** Connect the power cord to the monitor and plug it in to an AC power source.
- Step 2** Turn the monitor on by pressing the ON/OFF button. After one minute, the monitor should complete booting up. Observe there is a screen display and no error codes. If any error codes are displayed, refer to “Error Codes” in Chapter 5.
- Step 3** If you are using the Model V24CT/V26CT, make sure the battery Charging and Charged LEDs are behaving consistent with the battery charged. The following table describes the LED behavior:

Residual Capacity	Charging LED	Charged LED
Up to 40%	Flashing	Off
More than 40%, Less than 90%	Steady	Off
More than 90%	Off	Steady
Full	Off	Steady

If the pattern is not correct, refer to the troubleshooting chapter of this manual.

- Step 4** Turn the monitor on by pressing the ON/OFF button. If the screen comes up blank, there is a good chance you have the Flat Panel interface ribbon cable to the System PCB oriented incorrectly. Disconnect power and check the cable orientation. If the screen is still blank, refer the troubleshooting chapter.
- Step 5** If you are using the Model V24CT/V26CT, disconnect the AC power cord. The Model V24CT/V26CT should switch to battery power and the display will indicate that a battery measurement is in progress. After about 30 seconds, a battery gauge and two battery symbols appear in the lower right corner of the screen display.
- Step 6** If you are using the Model V24CT/V26CT, remove one of the batteries. The monitor should continue to operate. If the monitor does not continue to operate go to “Battery Problems” in the “Troubleshooting” chapter and check the fuses on the battery contact board. Repeat this procedure for the second battery.

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## Replacement of Backlight Tube Assembly

The intensity of the fluorescent tube used for backlight illumination of the Flat Panel Display will gradually decrease over time. As a result, periodic replacement may be necessary.

Agilent recommends replacement of the Backlight Tube Assembly (latest flat panel display) after 25000 hours (2.85 years) of continuous use or if there is noticeable decrease in the display illumination. The procedure for replacing the Backlight Tube Assembly depends on the model and can be found in the appropriate chapter on “Repairing”.

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## Battery Care and Handling

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### **CAUTION**

THE AGILENT MODEL V24CT/V26CT COMES WITH TWO SEALED LEAD-ACID BATTERIES. TO PREVENT DAMAGE TO THE BATTERIES, THE BATTERIES SHOULD BE CHARGED FULLY PRIOR TO USE.

Only batteries obtained from Agilent Technologies specifically for use with the Model V24CT/V26CT should be used. Use of other batteries could damage the Model V24CT/V26CT.

Upon receiving the Model V24CT/V26CT, fully charge the batteries before using the unit by inserting the batteries, leaving the unit off, and plugging the AC power cord into an AC source.

A battery's cycle life is the depth of discharge for each cycle. One cycle is equivalent to one discharge and then full recharge of the battery. A battery that has been subjected to a lower depth of discharge per cycle will have a longer cycle life than one with greater depths of discharge. An average battery will have a cycle life of 250 cycles depending upon the number and type of modules used and the depth of discharge.

Recharge the batteries to their full state after each use.

A battery will retain more of its residual capacity for a longer period of time if kept as cool as possible. Residual capacity drops from 100% charge to 50% charge over an 18 month period if the battery is kept at 20°C.

Store the batteries in a dry, cool place. A refrigerator is an excellent place to store batteries.

Never disassemble the batteries, or attempt to use broken or leaking batteries. The batteries use sulfuric acid as an electrolyte, and sulfuric acid can burn skin and clothes. If sulfuric acid does leak out of the batteries, wipe it up with a cloth and neutralize the acid with some available alkaline substance such as ammonium solution or sodium bicarbonate (baking soda). If the electrolyte should come in contact with skin or eyes, immediately flush the area with water and consult a physician.

Never short the contacts of the battery together, as it can burn out the connections and could damage the monitor. To this end, never remove the display assembly with the batteries installed.

Keep the batteries clean. Wipe the batteries with a dry cloth, or if necessary, use a water dampened cloth. Never use alcohol or other solvents to clean the battery.

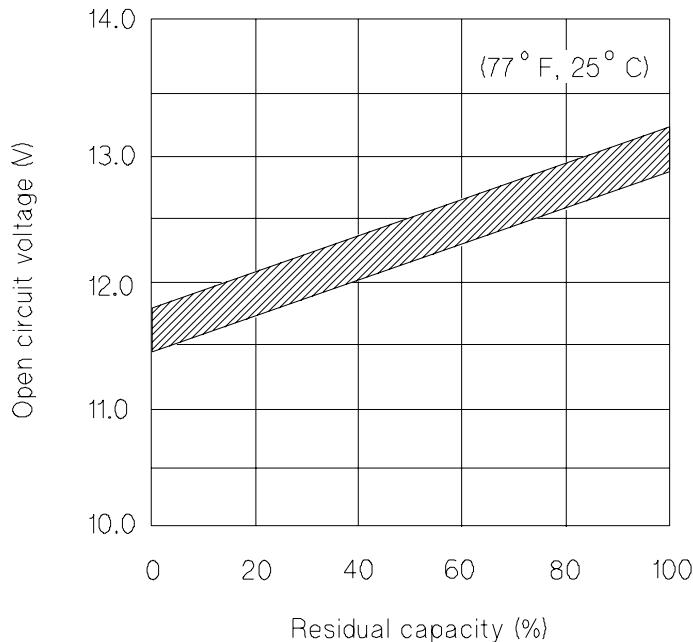
Dispose of batteries in approved containers. Do not incinerate the batteries. Batteries can explode if put into fire.

It is very important to never overdischarge a battery. The batteries used with the Model V24CT/V26CT are considered overdischarged if their voltage level is less than 9Vdc. This can occur due to storage at high temperatures, long storage times without recharge, or sustained connection to a load. A quick way to tell if a battery is overdischarged is if the Charging LED on the front panel does not flash during an attempted charge. This indicates that the batteries cannot be recharged in the monitor. However, they can be recharged with the M1278A External Battery Charger. If you do not have an M1278A then you must replace the batteries.

Charge stored batteries at least once every six months.

### Open Circuit Voltage and Residual Capacity

The residual capacity of the batteries can be estimated by measuring the open circuit voltage of the batteries and comparing it to the following figure.



**Figure 2-1 Open Circuit vs. Residual Capacity**

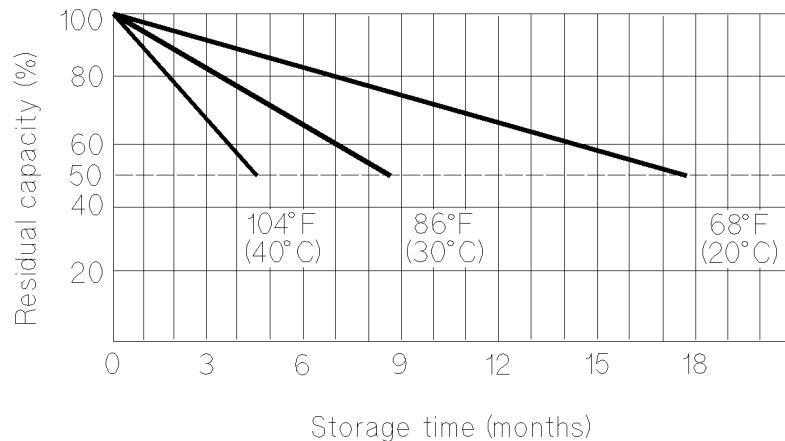
Use a voltmeter and measure each battery. For battery 1, the battery voltage can be sensed between pin 8 and ground. For battery 2, the voltage can be sensed between pin 6 and ground. The residual capacity of the batteries can be estimated by measuring the open circuit voltage

of the batteries and comparing it to Figure 2-1. If the batteries discharge much more quickly than expected by the graph, the batteries have exceeded their useful life and should be replaced.

Another way to test the capacity of the battery is to perform the charge and discharge test. Following a full charge, discharge the battery at 0.75 A to the end voltage of 10.5 V at an ambient temperature of 25°C ( $\pm 2^\circ\text{C}$ ) and then let it sit at the same temperature for one hour. Within 5 cycles of the charge and discharge test, the resultant discharge duration time should exceed 125 minutes. If the batteries discharge much more quickly than expected, the batteries have exceeded their useful life and should be replaced.

### Shelf Life and Temperature

The shelf life of the battery can be estimated by measuring the duration time of a discharge. To measure the duration time, discharge one battery at 0.75 A to the end voltage of 10.5 V at the ambient temperature of 25°C ( $\pm 2^\circ\text{C}$ ) and then let the battery stand 24 hours at this temperature. A battery that has been stored at an ambient temperature of 40°C ( $\pm 2^\circ\text{C}$ ) for four months should have a discharge duration time of 50 minutes. Compare your duration time to the information in Figure 2-2. If the batteries discharge much more quickly than expected by the graph, the batteries have exceeded their useful life and should be replaced.

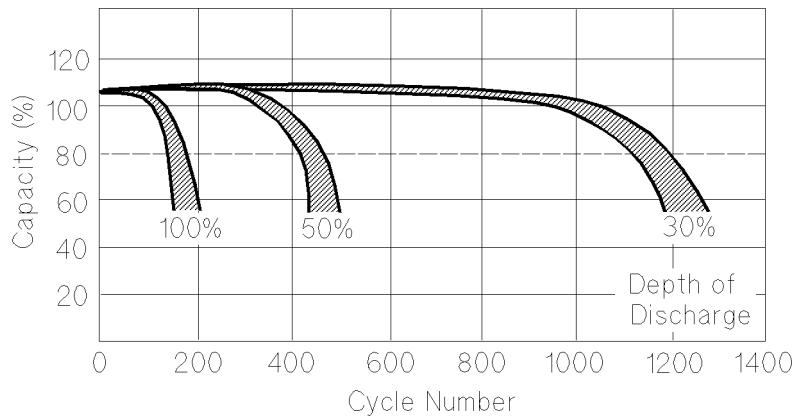


**Figure 2-2 Shelf Life vs. Storage Temperature**

### Cyclic Life

The cyclic life of a battery can be estimated by measuring the duration time of one cycle. For this test, one cycle consists of a discharge through a 16 ohm resistor to the end voltage of 10.5 V per battery and a charge of six hours with a charger that uses a charging voltage of 14.70 V ( $\pm 0.2$  V) and an initial maximum current of 0.92 A. The ambient temperature should be 25°C ( $\pm 2$ °C) for the test. Under these conditions, the cycle life shall be more than 150 cycles to the end of use when the duration time in discharging is 60 minutes.

The over-discharge recovery of the batteries can be estimated by using the following test procedure at an ambient temperature of 25°C ( $\pm 2$ °C). Connect the battery to a 16 ohm resistor and discharge the battery for 24 hours. Open the circuit and stand the battery for one month. Charge the battery for 24 hours with the specified charger (see Cycle Life above). Remove the battery from the charger and let it stand for one hour. Now discharge the battery at 0.75 A to the end voltage of 10.5 V. The duration time for the discharging should be more than 90 minutes. If the batteries discharge much more quickly than expected, the batteries have exceeded their useful life and should be replaced.



**Figure 2-3 Cyclic Life vs. Depth of Discharge**

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## Cleaning and Disinfecting Procedures

This section details the cleaning procedures for the System as a whole and for the Recorder and Blood Analysis Modules in particular.

### Objective

In order to meet the chapter's goals, you should be able to understand which cleaning and disinfecting agents you should use to safely clean an Agilent V24/V26 Series.

### Concepts

The V24/V26 Series monitors are composed of various different modules: the Display, the Plug-In Modules and the Module Rack. Each module contains connectors, controls or cables that should be cleaned regularly to ensure that they are in good condition and functioning normally.

Since the V24/V26 Series is used in situations where its modules may come in contact with human fluids, you should follow all of the procedures of your department for dealing with contaminated equipment.

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**WARNING**

**Agilent makes no claims regarding the efficacy of the listed chemicals or methods as a means for controlling infection. Consult your hospital's Infection Control Officer or Epidemiologist.**

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For comprehensive details on cleaning agents and their efficacy, refer to "Guidelines for Prevention of Transmission of Human Immunodeficiency Virus and Hepatitis B Virus to Health Care and Public-Safety Workers," issued by the U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, Atlanta, Georgia, February 1989.

## General Cleaning of the System

- The V24/V26 Series should be kept free of dust and dirt.
- Exterior cleaning of the case and screen is recommended. Clean it with a lint-free cloth, moistened with either warm water (40°C/104°F. max) and soap, a diluted non-caustic detergent or one of the approved cleaning agents listed below:

<b>Soaps</b>	mild soaps
<b>Tensides</b> (dishwasher detergents)	Edisonite Schnellreiniger® , Alconox®
<b>Ammonias</b>	Dilution of Ammonia <3%, Window cleaner
<b>Alcohol</b>	Ethanol 70%, Isopropanol 70%, Window cleaner

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<b>CAUTION</b>	To avoid damage to the product, observe the following general precautions for cleaning. You should only deviate when this is explicitly described in the cleaning instruction for the individual transducer or accessory.
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- Do not use strong solvents such as acetone or trichloroethylene.
- Always dilute according to the manufacturers instructions, or use lowest possible concentration.
- Never use abrasive material (such as steel wool or silver polish).
- Do not allow liquid to enter into the product.
- Never submerge any part of the system.
- Do not pour liquid onto the system during cleaning.
- Do not allow cleaning agent to remain on any of the equipment surfaces - wipe it off immediately with a cloth dampened with water.

## General Disinfecting of the System

We recommend that you disinfect the product only when necessary as determined by your hospital's policy, to avoid long term damage to the product.

We also recommend that the products being disinfected be cleaned first, as described under "General Cleaning of the System".

Use the recommended disinfecting substances listed below:

<b>Alcohol based</b>	Ethanol <sup>®</sup> 70%, Isopropanol 70%, Cytasept <sup>®</sup> , Hospisept <sup>®</sup> , Kodan Tinktur forte, Sagrosept <sup>®</sup> , Spitacid <sup>®</sup> , Sterilium fluid <sup>®</sup> . 1 only Ethanol 70% and Isopropanol 70% are tested and qualified
<b>Aldehyde based</b>	Dilution of formaldehyde (3-5%), Cidex <sup>®</sup> , Gigasept <sup>®</sup> , Kohrsolin <sup>®</sup> . 2 only Cidex is tested and qualified
<b>Bleach</b>	Dilution of sodium hypochlorite (laundry bleach): concentration ranging from 500ppm (1:100 dilution of household bleach) to 5000ppm (1:10 dilution of household bleach), Hydrogen peroxide 3%, Chlorox <sup>®</sup> (1:10 dilution), Dakin's Solution.
<b>Phenol based</b>	Wofasept <sup>®</sup> , Sporicidin <sup>®</sup> .

### CAUTION

To avoid damage to the product, observe the following general precautions for disinfection. You should only deviate when this is explicitly stated in the disinfecting instruction of a specific product.

- Do NOT use Povidone<sup>®</sup>, Sagrotan<sup>®</sup>, Mucocit<sup>®</sup> disinfecting agents or strong solvents e.g. acetone.
- Always dilute according to the manufacturer's instructions or use lowest possible concentration.
- Do not allow any liquid to enter the case.
- Never submerge any part of the system.
- Do not pour liquid onto the system during cleaning.
- Never use abrasive material (such as steel wool or silver polish).
- Do not allow any disinfecting agent to remain on any of the equipment surfaces – wipe it off immediately with a cloth dampened with water.

## Cleaning the Recorder Module

The paper roller and paper out sensors should be cleaned periodically.

- Step 1** Open the recorder door and remove the roll of paper, if present.
- Step 2** Use a lint free cloth and Isopropyl Alcohol to wipe the roller. Be sure to clean all sides of the roller.

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<b>CAUTION</b>	To avoid damage to the roller, do NOT use any of the following cleaning agents: - Dilute sodium hypochlorite (laundry bleach) - Dilute formaldehyde - Hydrogen peroxide
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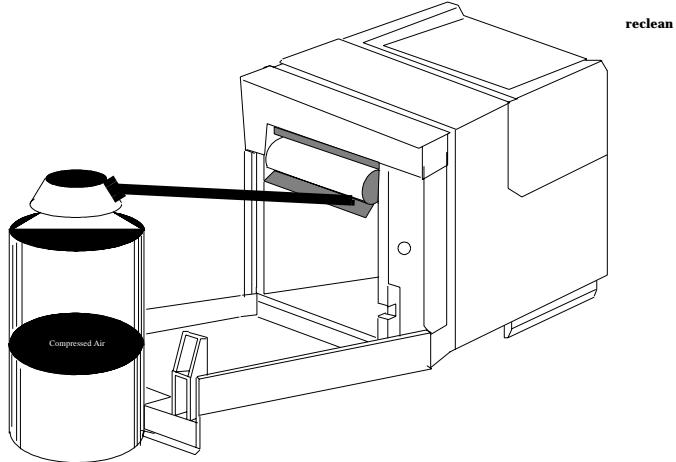
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- Step 3** Use the same cloth to clean the inside casing of the Recorder Module.

*The paper roller is cleaned to prevent paper slippage and to keep the recordings clean.*

*An optical sensor is used to detect when the recorder is out of paper. If an excessive amount of dust or dirt particles builds up around the sensor, the recorder will “think” it is out of paper even though this may not be the case.*

- Step 4** Use a bottle of compressed air to clean the paper out sensor that is located just below the paper roller.



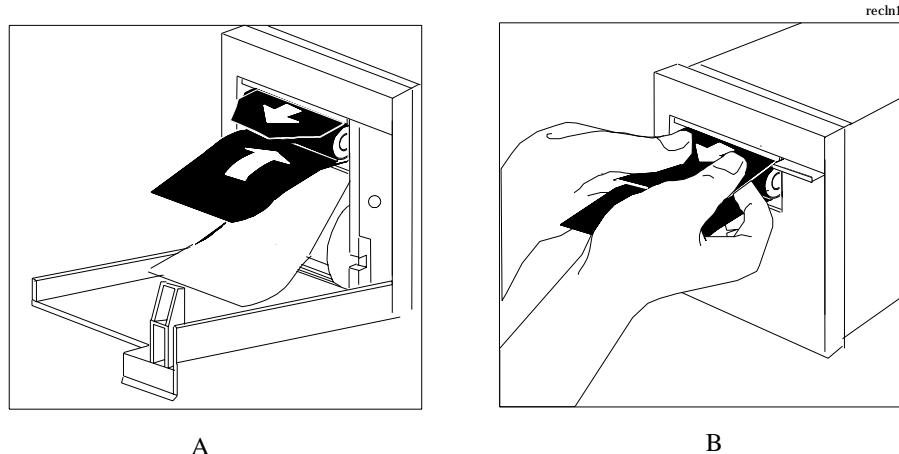
**Figure 2-4 Cleaning the paper out sensor**

The print head should also be cleaned periodically.

*If very slow speed (1 or 2 cm/min) recordings are run for extended periods of time, deposits of paper debris may collect on the printhead. Symptoms of this are recordings that are printed unevenly (have faint horizontal stripes).*

- Step 5** Thread a cleaning strip (included in the Recorder Module Cleaning Kit P/N M1116-60201) around the roller as in shown in diagram (A) below.
- Step 6** Close the recorder door, with both ends of the strip and the paper extending over the top of the door.
- Step 7** Grasp the top end of the strip as shown in diagram (B) below, and pull the strip out.

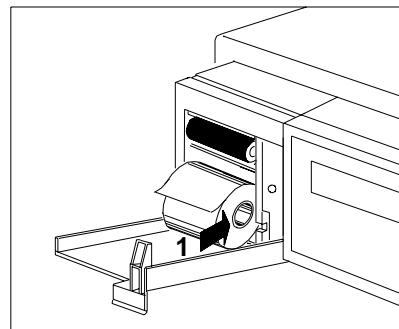
**Step 8** Open the door, re-thread the paper, and resume normal operation. (For best results use only Agilent Recorder Paper - P/N 40477A/B.)



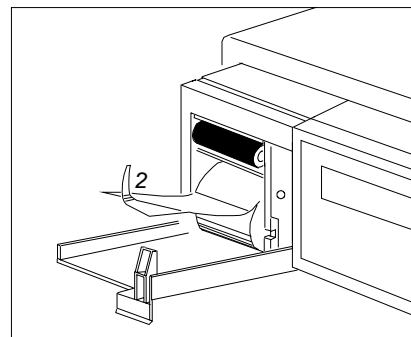
**Figure 2-5 Cleaning the Printhead of the Recorder Module**

### Replacing Recorder Paper

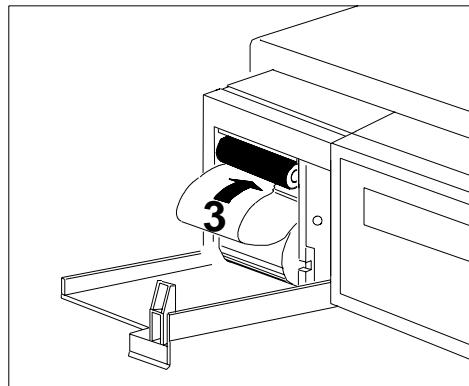
**Step 1** Open paper loading door and remove the remaining paper core.



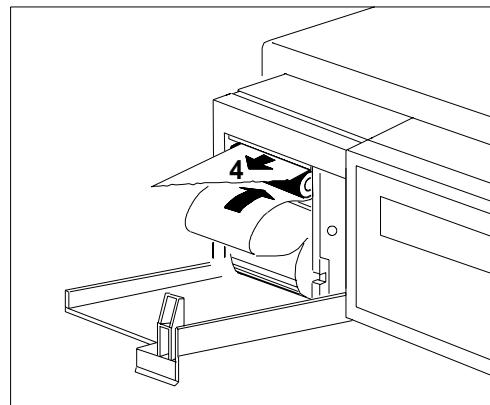
**Step 2** Pull out several inches of paper from new roll, holding roll so paper feeds from TOP.



- Step 3** Push roll into Thermal Recorder until it is centered securely on the roll hubs. Cut or tear off and discard first two inches of paper. Tear front edge of paper at an angle. Direct front point of paper towards recorder, and insert it over small plastic shelf under roll. Paper must enter Thermal Recorder with point on left side, otherwise it may resist feeding through.



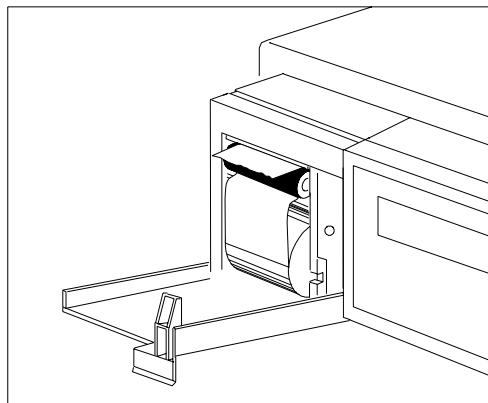
- Step 4** Push front edge of paper over shelf until paper goes around roller and comes out above it. Pull paper straight out (but loosely) down until it is draped over end of paper loading door.



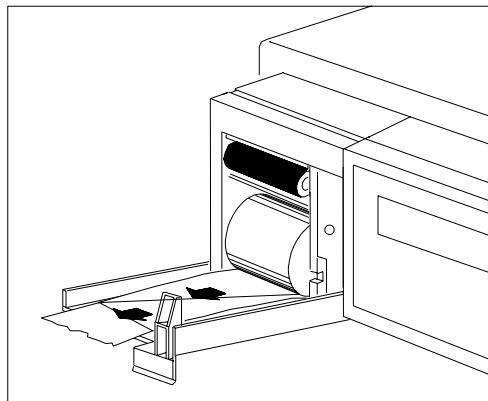
## Removing Paper Loaded Backwards

If paper is loaded backwards in the thermal recorder, perform the following:

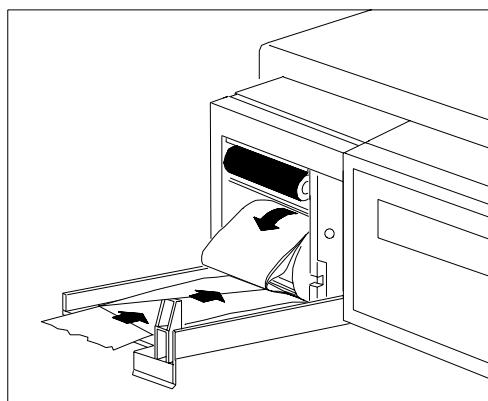
- Step 1** Tear off paper and open thermal recorder door.



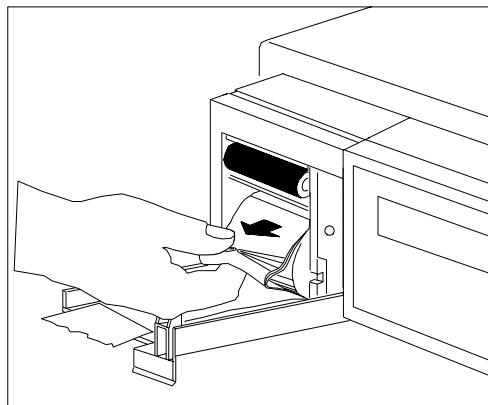
- Step 2** Pinch paper at shelf below roller, and pull paper off of the roller.



- Step 3** Gently push paper back on to paper roll.



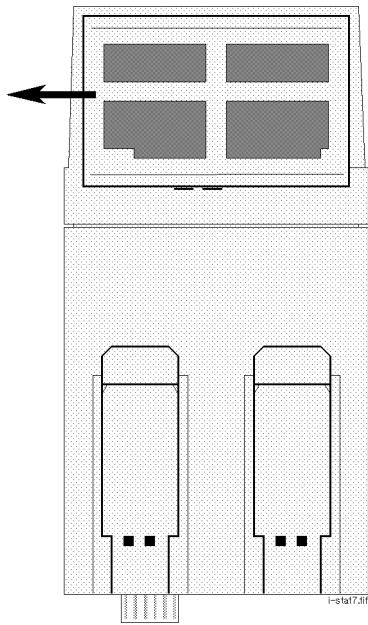
- Step 4** With paper rolled loosely, pinch several thicknesses of loose paper at the front of the roll, and pull roll out from thermal recorder. Perform paper changing procedure.



## Cleaning the Blood Analysis Module

The filter for the ventilator fan should be cleaned periodically.

- Step 1** Slide the filter cover on the underside of the module to the left and remove.



- Step 2** Remove the filter from the cover.

- Step 3** Rinse the filter under running water to remove any dust or debris.

- Step 4** Shake the filter and leave to dry before replacing in the cover.

## Upgrade and Cloning Instructions

In this section, you will learn how to use the Agilent Programming Tool to upgrade or reload software, and to perform EEPROM cloning of your V24/V26 Series monitor.

To perform the procedures described in this section, you will need the Agilent Programming Tool Kit (M2300-67100) and a Flash Card. Instructions for the troubleshooting and maintenance of the Flash Upgrade Tool itself are included in the documentation which ships with the kit.

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**NOTE**


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The Model V24CT/V26CT color instrument requires software revision E minimum.

### Parts Checklist

Before beginning the installation or upgrade, refer to the Software Number tables below and make sure that you have the correct flash card part number.

#### Software Releases A.0/B.0/C.0 Flash Card Part Numbers V24/V26 Series - all serial numbers

**x = D for Rel. A.0**  
**x = E for Rel. B.0**  
**x = F for Rel. C.0**

Flash Card Language	Agilent Use Only		Customer Use	
	Exchange Part Number	New Part Number	Exchange Part Number	New Part Number
English	M1204-7801x	M1204-7401x	M1204-7901x	M1204-7501x
French	M1204-7802x	M1204-7402x	M1204-7902x	M1204-7502x
German	M1204-7803x	M1204-7403x	M1204-7903x	M1204-7503x
Dutch	M1204-7804x	M1204-7404x	M1204-7904x	M1204-7504x
Spanish	M1204-7805x	M1204-7405x	M1204-7905x	M1204-7505x
Italian	M1204-7806x	M1204-7406x	M1204-7906x	M1204-7506x
Norwegian	M1204-7807x	M1204-7407x	M1204-7907x	M1204-7507x
Swedish	M1204-7808x	M1204-7408x	M1204-7908x	M1204-7508x
Finnish	M1204-7809x	M1204-7409x	M1204-7909x	M1204-7509x
Japanese	M1204-7810x	M1204-7410x	M1204-7910x	M1204-7510x
Danish	M1204-7811x	M1204-7411x	M1204-7911x	M1204-7511x
Traditional Chinese	M1204-7812x	M1204-7412x	M1204-7912x	M1204-7512x
Simplified Chinese	M1204-7813x	M1204-7413x	M1204-7913x	M1204-7513x
Portuguese	M1204-7814x	M1204-7414x	M1204-7914x	M1204-7514x
Greek	M1204-7815x	M1204-7415x	M1204-7915x	M1204-7515x
Russian	M1204-7817x	M1204-7417x	M1204-7917x	M1204-7517x
Czech	M1204-7818x	M1204-7418x	M1204-7918x	M1204-7518x
Polish	M1204-7820x	M1204-7420x	M1204-7920x	M1204-7520x

**Software Revision E.00.07 Flash Card Part Numbers**

Flash Card Language	Agilent Use Only		Customer Use	
	Exchange Part Number	New Part Number	Exchange Part Number	New Part Number
ENGLISH	M1204-7801B	M1204-7401B	M1204-7851B	M1204-7451B
FRENCH	M1204-7802B	M1204-7402B	M1204-7852B	M1204-7452B
GERMAN	M1204-7803B	M1204-7403B	M1204-7853B	M1204-7453B
DUTCH	M1204-7804B	M1204-7404B	M1204-7854B	M1204-7454B
SPANISH	M1204-7805B	M1204-7405B	M1204-7855B	M1204-7855B
ITALIAN	M1204-7806B	M1204-7406B	M1204-7856B	M1204-7456B
SWEDISH	M1204-7807B	M1204-7407B	M1204-7857B	M1204-7457B
FINNISH	M1204-7808B	M1204-7408B	M1204-7858B	M1204-7458B
NORWEGIAN	M1204-7809B	M1204-7409B	M1204-7859B	M1204-7459B
DANISH	M1204-780AB	M1204-740AB	M1204-785AB	M1204-745AB
JAPANESE	M1204-780BB	M1204-740BB	M1204-785BB	M1204-745BB
TRADITIONAL CHINESE	M1204-780CB <sup>1</sup> M1204-780DB <sup>1</sup>	M1204-740CB <sup>1</sup> M1204-740DB <sup>1</sup>	M1204-785CB <sup>1</sup> M1204-785DB <sup>1</sup>	M1204-745CB <sup>1</sup> M1204-745DB <sup>1</sup>
SIMPLIFIED CHINESE	M1204-780EB	M1204-740EB	M1204-785EB	M1204-745EB

<sup>1</sup>For traditional Chinese there are two separate flash card part numbers (both are required):

xxCB denotes Utility software

xxDB denotes Application software

**NOTE**

Do not load the E.00.06 or improved software onto the M1204-60100; they are not compatible. The board is upgradable.

**Software Revision C.04.01 Flash Card Part Numbers**  
**Model V24 Monochrome only - serial prefix less than 3628**

Flash Card Language	Agilent Use Only		Customer Use	
	Exchange Part Number	New Part Number	Exchange Part Number	New Part Number
ENGLISH	M1204-78041	M1204-74041	M1204-78541	M1204-74541
FRENCH	M1204-78042	M1204-74042	M1204-78542	M1204-74542
GERMAN	M1204-78043	M1204-74043	M1204-78543	M1204-74543
DUTCH	M1204-78044	M1204-74044	M1204-78544	M1204-74544
SPANISH	M1204-78045	M1204-74045	M1204-78545	M1204-74545
ITALIAN	M1204-78046	M1204-74046	M1204-78546	M1204-74546
SWEDISH	M1204-78047	M1204-74047	M1204-78547	M1204-74547
FINNISH	M1204-78048	M1204-74048	M1204-78548	M1204-74548
NORWEGIAN	M1204-78049	M1204-74049	M1204-78549	M1204-74549
DANISH	M1204-78050	M1204-74050	M1204-78550	M1204-74550
JAPANESE	M1204-78051	M1204-74051	M1204-78551	M1204-74551
TRADITIONAL CHINESE	N/A	N/A	N/A	N/A
SIMPLIFIED CHINESE	M1204-78053	M1204-74053	M1204-78553	M1204-74553

**NOTE**

Software revision C.04.01 replaces C.02.xx and C.03.01. Not compatible with Model V24C/V26C (color) and Model V24CT/V26CT (color, battery).

## Connecting the Flash Programming Tool

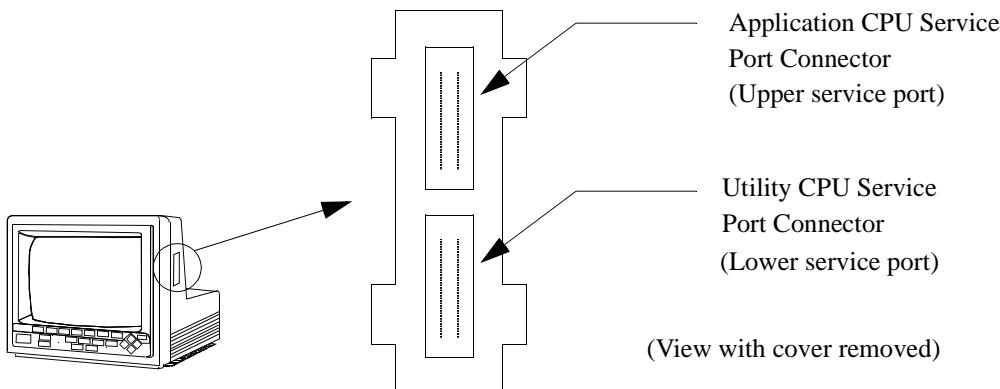
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**CAUTION**

Always power down monitor before connecting/disconnecting Flash Programming Tool or inserting/removing flash card.

To connect the Flash Programming Tool to the V24/V26 Series monitor, complete the following steps:

- Step 1** Turn the monitor power switch OFF.
- Step 2** Attach the banana-plug connector end of the ground wire to one of the two ground-jacks on the tool. Attach the alligator-clip end of the ground wire to the equipotential ground lug on the rear of the monitor.
- Step 3** Properly ground yourself by either attaching the alligator-clip end of an anti-static wrist strap to the earth ground lug on the rear of the monitor, or by attaching the wrist strap to the programming tool via a banana-plug.
- Step 4** Using a small flat-bladed screwdriver, remove the service port connector cover located on the right side of the monitor. As shown below, there are two service ports behind the cover. The upper port is for servicing the Application CPU (application software upgrades, EEPROM upgrades); the lower port is for servicing the Utility CPU.



**Figure 2-6 Access to the Service Ports**

---

**NOTE**

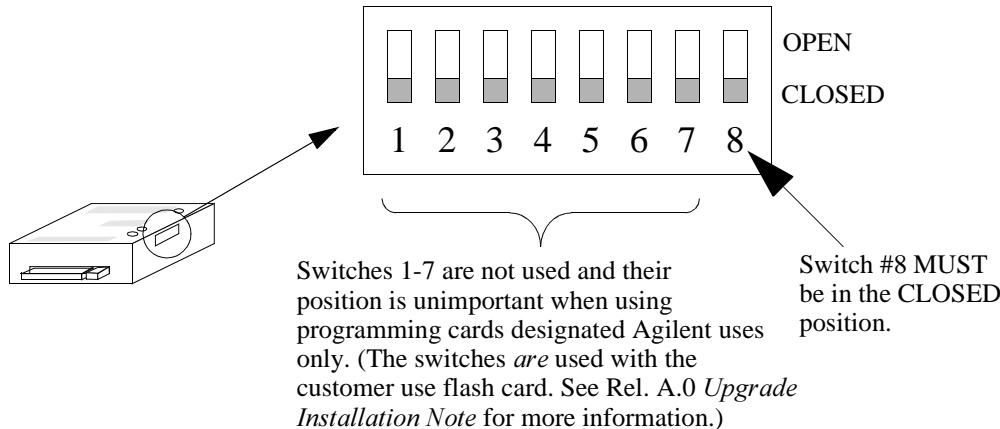
There is a strict order of precedence which must be followed when programming software. The Utility CPU MUST be upgraded first. The Application CPU MUST be programmed after the Utility CPU.

If you attempt to upgrade the Application CPU prior to upgrading the Utility CPU, you will see an error message informing you of application software incompatibility.

- Step 5** As shown below, set switch 8 on the tool to the closed (down) position. This ensures that the monitor will boot from the programming tool.

**Step 6** Insert the appropriate flash card into the programming tool.

**Step 7** Connect one end of the service tool cable to the service port connector on the programming tool. Depending upon the task to be performed, you will connect the other end of the cable to the appropriate service port connector on the monitor.



**Figure 2-7 Programming Tool DIP Switch Settings**

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**NOTE**

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The software version and part numbers shown in this document are for example purposes only. The numbers for the software which you are upgrading or reprogramming may vary.

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**NOTE**

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References to the following softkeys are only applicable to programming cards designated for “Agilent use only”.

1. Edit Serial No.
2. Password Entry
3. More EEPROMs
4. Select EEPROM

## Upgrading the Utility CPU Software

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**CAUTION**

Monitor power must be off before proceeding!

**Step 1** Connect the unattached end of the service port cable to the *lower* service port on the V24/V26 Series monitor.

**Step 2** Turn the V24/V26 Series monitor power switch ON.

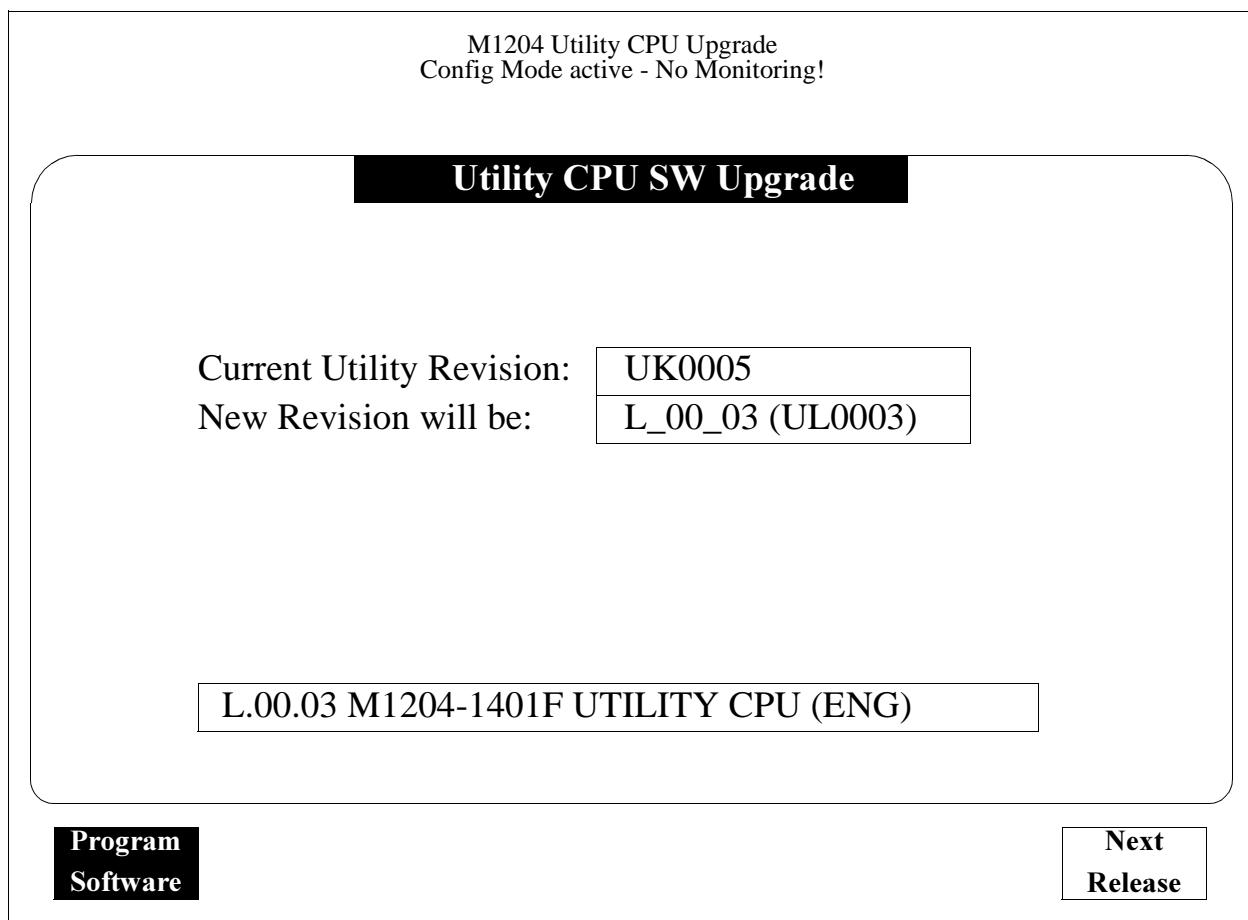
**Step 3** The screen displays the status message

Press the **Monitor Setup** hardkey to display the Instrument Configuration screen. The screen displays the following softkeys:

- **Password Entry**
- **Monitor Revision**
- **UTIL SW Upgrade**

To provide security against unauthorized use, the **UTIL SW Upgrade** softkey is disabled (hollow) until the password is entered.

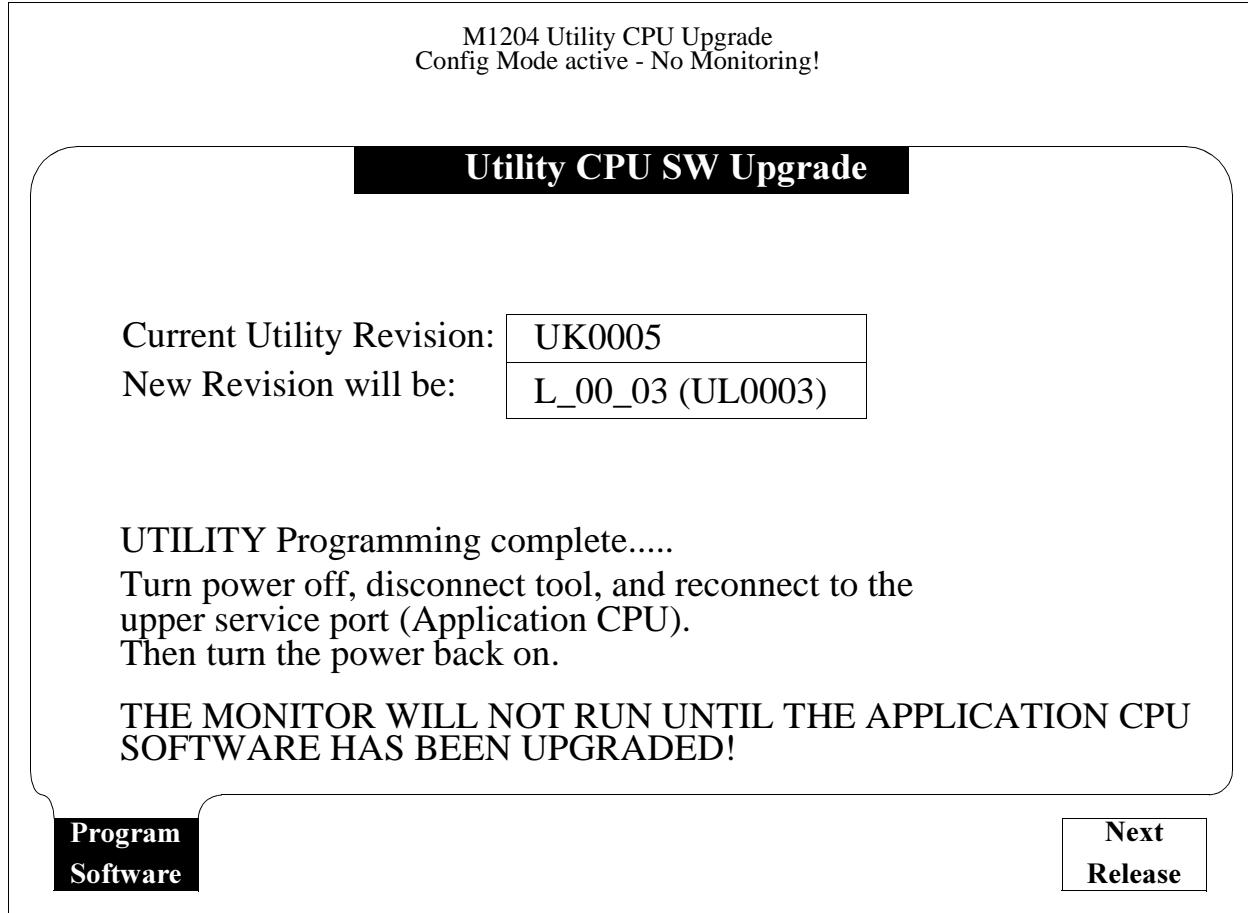
**Step 4** Select the **Password Entry** softkey, enter the password, and press the **Confirm** hardkey. The system displays a message which informs you that you are now entering upgrade mode, where you are able to switch on copyright-protected software.



**Figure 2-3 Utility CPU Software Upgrade Screen**

**Note:** This figure and the following Software Upgrade Screen figures are for illustration purposes only and do not show upgrades to the latest release, A.0.

**Step 6** Press the **Program Software** softkey, followed by the **Confirm** hardkey to verify the selection. The system begins the utility software upgrade, a process which takes approximately 30 seconds. When the upgrade process is complete, the system displays a screen similar to one shown below.



**Figure 2-4 Utility CPU Software Upgrade Complete Screen**

**Step 7** Turn the V24/V26 Series monitor OFF and disconnect the service port cable from the lower service port.

As the screen indicates, proceed to the next section and upgrade the application CPU software.

## Upgrading the Application CPU Software

### **WARNING**

Enter the default password, 1175, on the first use of the Programming Tool, then set your own password. This should not be written down or made available to non-Agilent personnel. Once a new password is entered, the default password cannot be re-entered. It is extremely important that the new password be remembered since all other users will be locked out. The password will belong to the upgrade tool, not the Flash Memory Card that is plugged into the tool.

### **CAUTION**

Monitor power must be off before proceeding!

- Step 1** Connect the unattached end of the service port cable to the *upper* service port on the V24/V26 Series monitor.
- Step 2** Turn the V24/V26 Series monitor power switch ON. The screen displays the status message Config Mode Active - NO MONITORING!
- Step 3** Press the **Monitor Setup** hardkey to display the initial Instrument Configuration screen.
- Step 4** Press the **Password Entry** softkey, enter the password, and press **Confirm** to display the Instrument Configuration screen

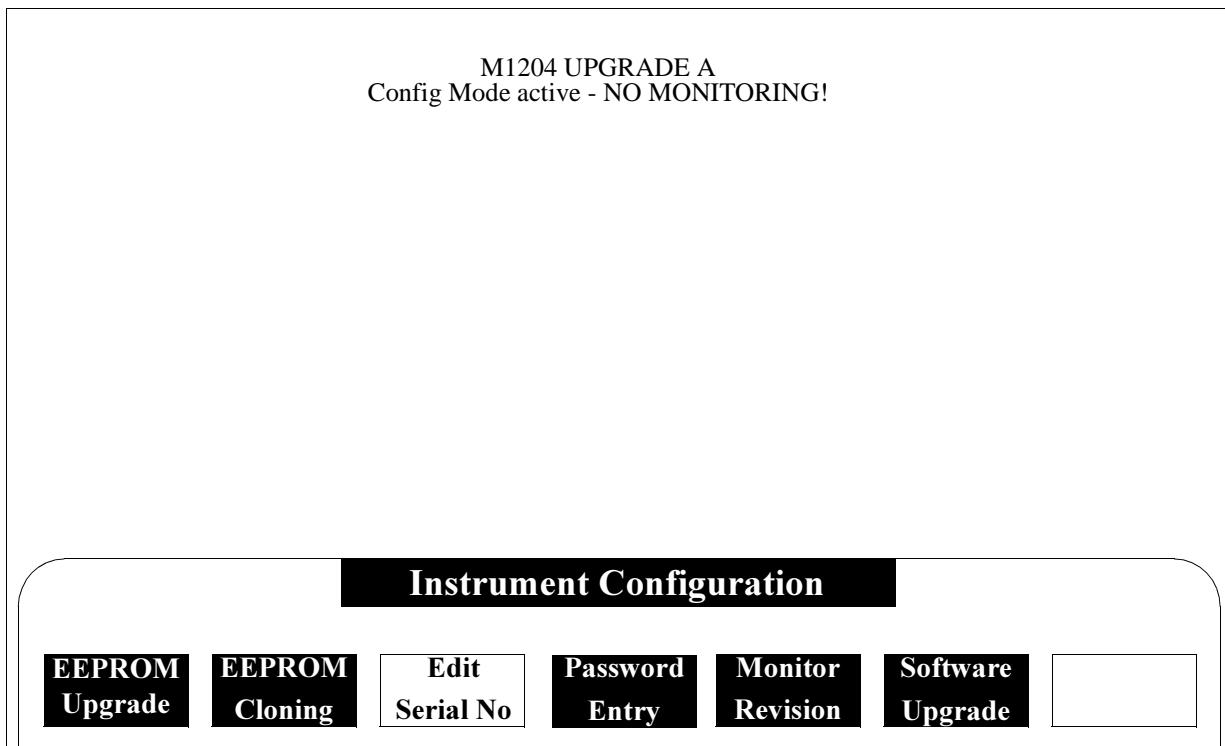
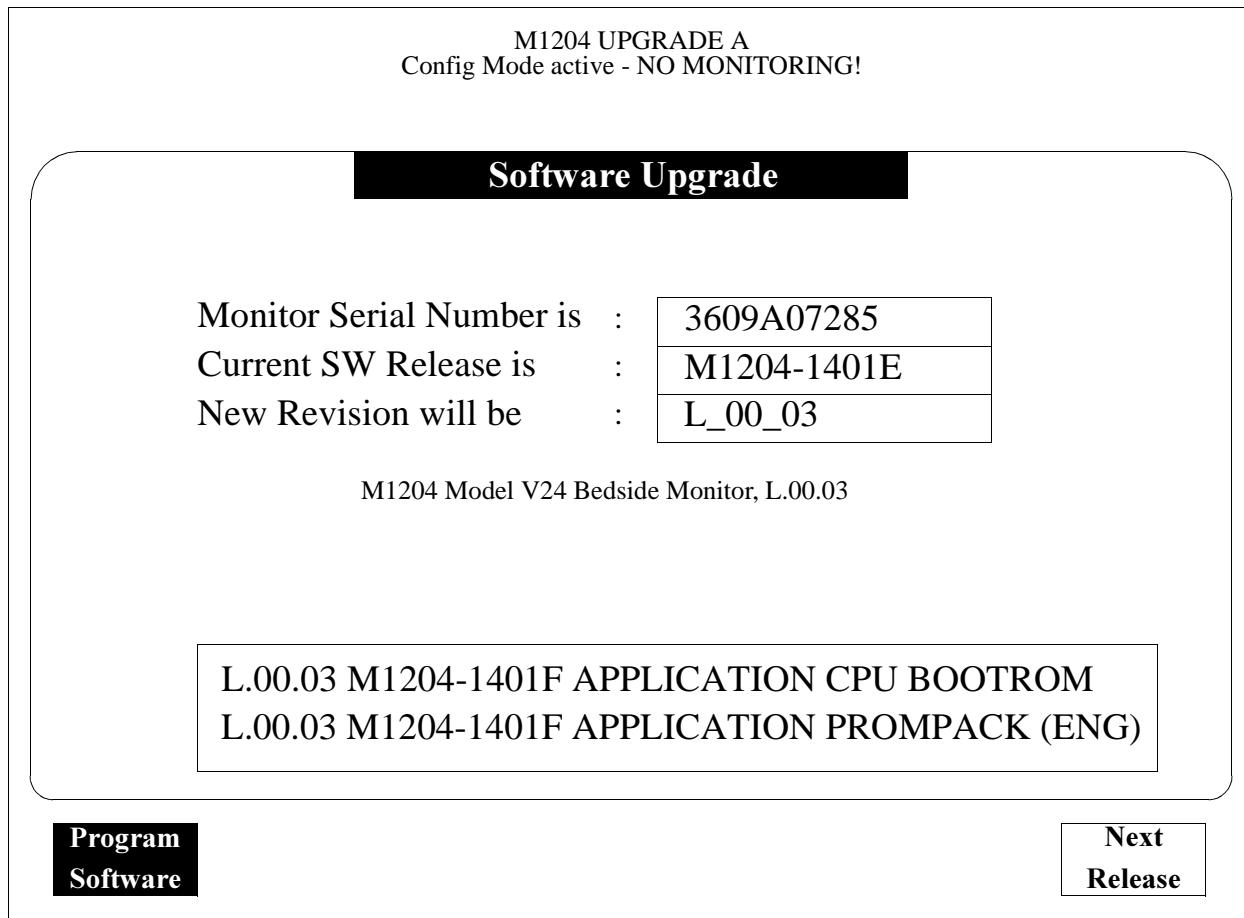


Figure 2-5 Application Upgrade screen after password entry

- Step 5** Press the **Software Upgrade** softkey to display the Application Software Upgrade screen.



**Figure 2-6 Application CPU Software Upgrade Screen**

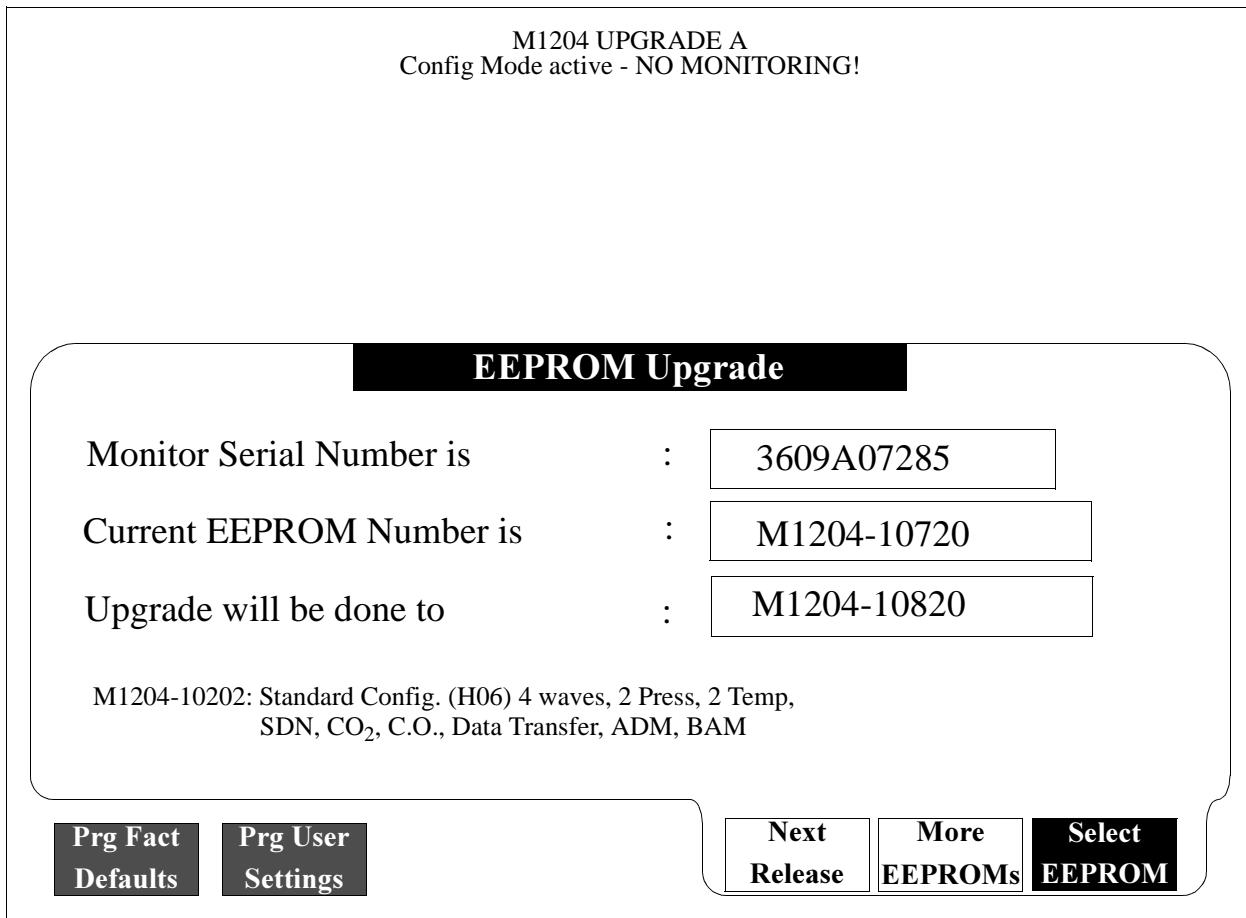
- Step 6** Press the **Program Software** softkey, followed by the **Confirm** hardkey to complete the upgrade, a process which takes approximately 2 minutes. Once the process is completed, the system displays the message **SW upgrade complete**.
- Step 7** Press the **Monitor Setup** hardkey to return to the Instrument Configuration screen.
- Step 8** To upgrade the EEPROM, proceed to the next section, otherwise power down the monitor, disconnect the Flash Programming Tool and reinstall the service port connector cover.
- Step 9** Power up the monitor and erase the Status Log. (Press **Monitor Setup**, **More Choices**, **Status Log**, and **Erase Stat Log**.)
- Step 10** Perform the Performance Assurance test indicated in this chapter.

## Performing an EEPROM Upgrade

You may use this function when repairing a failed EEPROM, replacing a board, or for future upgrades.

- Step 1** From the Instrument Configuration screen, press the **EEPROM Upgrade** softkey to display the EEPROM Upgrade main screen.
- Step 2** Press the **Select EEPROM** softkey to display the Select EEPROM screen shown in Figure 2-7.
- Step 3** Press **Select EEPROM** again to select the EEPROM upgrade (indicated on the screen after the message *Upgrade will be done to:*)
- Step 4** Complete one of the following steps:
  - a. To perform an EEPROM upgrade *without saving customer configuration settings*, press **Prg Fact Defaults**.
  - b. To perform an EEPROM upgrade *and save customer configuration settings*, press **Prg User Settings**.
- Step 5** Press **Confirm** to begin the programming process. The system displays the message *EEPROM programming in process*. When the process is complete (approximately one minute) the system displays the message *... Programming done*.
- Step 6** Press **Monitor Setup** to return to the Instrument Configuration screen.
- Step 7** Power down the monitor, disconnect the Flash Programming Tool and reinstall the service port connector cover.
- Step 8** Power up the monitor and erase the Status Log. (Press **Monitor Setup**, **More Choices**, **Status Log**, and **Erase Stat Log**.)
- Step 9** Perform the Performance Assurance test indicated in this chapter.

**Note:** The following EEPROM Upgrade or Cloning Screen figures are for illustration purposes only and do not show upgrades to the latest release, A.0.



**Figure 2-7 EEPROM Upgrade Select Screen**

## EEPROM Number Tables

The following EEPROM tables show the only possible combinations of options

Software Release C.0 EEPROM Part Numbers V24/V26 Series - all serial numbers							
	Option		EEPROM Part number		Option		EEPROM Part number
ICU	H06		M1204-10820	Anesthesia OR	H34		M1204-11830
		D21	M1204-10821		D21		M1204-11831
		C06	M1204-10822		C06		M1204-11832
		C06, C12	M1204-10823		C10		M1204-11833
		C12	M1204-10824		C10,C06		M1204-11834
	H07		M1204-10860		C10,C12		M1204-11835
		D21	M1204-10861		C06,C12		M1204-11836
		C06	M1204-10862		C10,C06,C12		M1204-11837
		C10	M1204-10863		C12		M1204-11838
		C10,C06	M1204-10864	H35			M1204-11840
Neonatal	H24		M1204-10830		D21		M1204-11841
		D21	M1204-10831		C06		M1204-11842
		C06	M1204-10832		C06,C12		M1204-11843
		C04	M1204-10833		C12		M1204-11844
		C04, C06	M1204-10834		H36		M1204-11850
	H25		M1204-10840		D21		M1204-11851
		D21	M1204-10841		C06		M1204-11852
		C06	M1204-10842		C10		M1204-11853
	H26		M1204-10850		C10,C06		M1204-11854
		D21	M1204-10851		C10,C12		M1204-11855
		C06	M1204-10852		C06,C12		M1204-11856
		C04	M1204-10853		C10,C06,C12		M1204-11857
		C04,C06	M1204-10854		C12		M1204-11858
Cardiac <sup>1</sup>	H41		M1204-10805	Cardiac <sup>1</sup> H41	D21		M1204-10801
					C06		M1204-10802
					C10		M1204-10808
					C10,C06		M1204-10807
					C10,D21		M1204-10809
	H42		M1204-10815				M1204-10815
					D21		M1204-10811
					C06		M1204-10812
					C10		M1204-10818
					C10,C06		M1204-10817

<sup>1</sup>. C12, EASI are standard in these bundles

Software Release B.0 EEPROM Part Numbers V24/V26 Series - all serial numbers							
	Option		EEPROM Part number		Option		EEPROM Part number
ICU	H04		M1204-10700	ICU classic	H07		M1204-10760
		D21	M1204-10701			C06	M1204-10762
		C06	M1204-10702			C10	M1204-10763
		C10	M1204-10703			C10,C06	M1204-10764
		C10,C06	M1204-10704			C10,C12	M1204-10765
		C10,C12	M1204-10705			C06,C12	M1204-10766
		C06,C12	M1204-10706			C06,C10,C12	M1204-10767
		C10,C06,C12	M1204-10707		H08		M1204-10770
	H05		M1204-10710			C06	M1204-10772
		D21	M1204-10711			C10	M1204-10773
OR	H06		M1204-10712	Neonatal	H09		M1204-10780
		C06	M1204-10713			C06	M1204-10782
		C10	M1204-10714			C10	M1204-10783
		C10, C06	M1204-10715			C10,C06	M1204-10784
		C10, C12	M1204-10716			C10,C12	M1204-10785
		C06, C12	M1204-10717			C06,C12	M1204-10786
	H14		M1204-11700			C06,C10,C12	M1204-10787
		D21	M1204-11701		H24		M1204-10730
		C06	M1204-11702			D21	M1204-10731
		C10	M1204-11703			C06	M1204-10732
Anesthesia	H15		M1204-11704			C04	M1204-10733
		C10, C06	M1204-11710			C04, C06	M1204-10734
	H16		M1204-11711		H25		M1204-10740
		D21	M1204-11712			D21	M1204-10741
		C06	M1204-11722			C06	M1204-10742
		C10	M1204-11723		H26		M1204-10750
		C10,C06	M1204-11724			D21	M1204-10751
		C10, C12	M1204-11725			C06	M1204-10752
		C06, C12	M1204-11726			C04	M1204-10753
		C10, C06, C12	M1204-11727			C04,C06	M1204-10754
OR	H34		M1204-11730	Anesthesia	H36		M1204-11750
		D21	M1204-11731			D21	M1204-11751
		C06	M1204-11732			C06	M1204-11752
		C10	M1204-11733			C10	M1204-11753
		C10,C06	M1204-11734			C10,C06	M1204-11754
	H35		M1204-11740			C10,C12	M1204-11755
		D21	M1204-11741			C06,C12	M1204-11756
		C06	M1204-11742			C10,C06,C12	M1204-11757
		C06, C12	M1204-11743				

Software Release A.0 EEPROM Part Numbers V24/V26 Series - all serial numbers							
	Option		EEPROM Part number		Option		EEPROM Part number
ICU	H04		M1204-10600	ICU classic	H07		M1204-10660
		D21	M1204-10601			C06	M1204-10662
		C06	M1204-10602			C10	M1204-10663
		C10	M1204-10603			C10,C06	M1204-10664
		C10, C06	M1204-10604		H08		M1204-10670
	H05		M1204-10610			C06	M1204-10672
		D21	M1204-10611			C10	M1204-10673
		C06	M1204-10612			C10,C06	M1204-10674
		C10	M1204-10613		H09		M1204-10680
		C10, C06	M1204-10614			C06	M1204-10682
OR	H06		M1204-10620			C10	M1204-10683
		D21	M1204-10621			C10,C06	M1204-10684
		C06	M1204-10622				
			M1204-11600	Neonatal	H24		M1204-10630
		D21	M1204-11601			D21	M1204-10631
		C06	M1204-11602			C06	M1204-10632
		C10	M1204-11603			C040	M1204-10633
		C10, C06	M1204-11604			C04, C06	M1204-10634
			M1204-11610		H25		M1204-10640
		D21	M1204-11611			D21	M1204-10641
Anesthesia	H15		M1204-11612			C06	M1204-10642
			M1204-11620		H26		M1204-10650
		D21	M1204-11621			D21	M1204-10651
		C06	M1204-11622			C06	M1204-10652
		C10	M1204-11623			C04	M1204-10653
		C10,C06	M1204-11624			C04,C06	M1204-10654
			M1204-11630	Anesthesia OR	H35	C06	M1204-11642
	H34	D21	M1204-11631		H36		M1204-11650
		C06	M1204-11632			D21	M1204-11651
		C10	M1204-11633			C06	M1204-11652
		C10,C06	M1204-11634			C10	M1204-11653
			M1204-11640			C10,C06	M1204-11654
		D21	M1204-11641				

**Table 1-5 Release C.0 Functionality and Options**

Functionality		ICU		NEO			OR			Cardiac	
		H06	H07 <sup>1</sup>	H24	H25	H26	H34	H35	H36	H41	H42
SDN		●	●	●	●		●	●		●	●
RS232	J13	○	○	○	○	○	●	●	●	○	○
Recorder		●	●	●	●	●	●	●	●	●	●
Data Transfer		●	●			●		●			
Drug Calculation		●	●		●	●		●		●	●
Split Screen		●		●	●	●	●	●	●	●	●
oxyCRG				●	●	●					
ST Segment Analysis	C10 <sup>2</sup>		○				○		○	○	○
Anesthetic Gas Module							●	●	●		
Neonatal Event Review	C04			○		○					
EASI ECG	C12 <sup>2</sup>	○	○				○	○	○	●	●
Printer Package				●						●	●
Max. Plug-in Modules		8	8	8	8	8	8	8	8	8	8
Number of Waves	D21,C06 <sup>2</sup>	3,4,6	3,4,6	3,4,6	3,4,6	3,4,6	3,4,6	3,4,6	3,4,6	3,4,6	3,4,6
Blood Analysis Interface		●			●			●			
Blood Analysis Module		●			●	●		●	●		
Temperature		2	2	2	2	2	1	2	1	2	2
Cardiac Output		1	1		1		1	1	1	1	
Inv.Pressure		2	3	2	2	2	2	2	2	2	2
CO2		1	1	1	1		1	1	1		
TcGas				1	1	1					
Vuelink Type A		1	1	1	1	1	1	1	1		
Vuelink Type B <sup>3</sup>		1	1/2	1	1	1	1/2	1	1/2		1
BIS							●	●	●		

1. No BAM data from Data Transfer Module

2. Not compatible with D21 (3-wave version)

3. 2 Vuelink B Modules are only supported if no ST (option C10) is selected

**Table 1-6 Release A.0/B.0 Functionality and Options**

Functionality ● = Standard in this Model ○ = Optional available = not available		ICU						OR			NEO			OR		
		H04	H05	H06	H07	H08	H09	H14	H15	H16	H24	H25	H26	H34	H35	H36
Interfacing	SDN	●	●	●	●	●	●	●	●		●	●		●	●	
	RS232	J13	○	○	○	○	○	●	●	●	○	○	○	●	●	●
	Recorder		●	●	●	●	●	●	●	●	●	●	●	●	●	●
Application	Data Transfer			●	●	●	●		●				●		●	
	Drug Calculation				●	●	●		●			●	●			●
	Split Screen				●			●	●	●	●	●	●	●	●	●
	oxyCRG										●	●	●			
	ST Segment Analysis <sup>1</sup>	C10	○	○		○	○	○	○	○				○		○
	Anesthetic Gas Module													●	●	●
	Tabular Trends		●	●	●	●	●	●	●	●	●	●	●	●	●	●
Plug-in Modules	Neonatal Event Review	C04									○	○				
	Max. Plug-in Modules		8	8	8	8	8	8	8	8	8	8	8	8	8	8
	Number of Waves	D21,C06 <sup>1</sup>	3,4,6	3,4,6	3,4,6	4,6	4,6	4,6	3,4,6	3,4,6	3,4,6	3,4,6	3,4,6	3,4,6	3,4,6	3,4,6
	Blood Analysis Interface				●				●			●			●	
	Blood Analysis Module				●				●	●		●	●		●	●
	Temperature		1	2	2	2	2	2	1	2	2	2	2	1	2	2
	Cardiac Output		1		1	1	1	1	1	1	1	1	1	1	1	1
	Inv.Pressure		2	3	2	3	3	2	2	2	2	2	2	2	2	2
	CO2		1	1	1		1	1	1	1	1	1	1			
	TcGas											1	1	1		
Vuelink Type A			1		1				1	1	1	1	1	1	1	1
	Vuelink Type B			1	1	1	1		1	1	1	1	1	1	1	1

**Release B.0 Features only**

EASI ECG <sup>2</sup>	C12	○	○	○	○	○	○		○	○				○	○
New SpO2		●	●	●	●	●	●	●	●	●	●	●	●	●	●

1. Not compatible with D21 (3-wave version)

2. EASI ECG is available with all 6-wave versions and with 4-wave versions that include option C10 (ST Segment Analysis)

Software Revision E.00.07 EEPROM Part Numbers			
Option	Part number	Option	Part number
ICU	M1204-10401	Anesthesia (H01)	M1204-10421
	M1204-10402		M1204-10422
	M1204-10403		M1204-10423
	M1204-10404		M1204-10424
	M1204-10405		M1204-10425
	M1204-10406		M1204-10426
Neonatal (H02)	M1204-10441	Anesthesia (H03)	M1204-10461
	M1204-10443		M1204-10462
	M1204-10444		M1204-10463
			M1204-10465

Option	Description
C10	ST Segment Analysis
D20	Delete Advance Data Management
D21	3-wave display

EEPROM Configurations (Application Bundles) -- Revision E.00.07			
Standard		Neonatal (H02)	
<ul style="list-style-type: none"> <li>• Adult/ICU Defaults; Switchable unit types, ICU/ OR</li> <li>• 3 Invasive Pressures</li> <li>• 2 Temperatures &amp; DiffT</li> <li>• Split Screen Trends</li> <li>• No tcGas, oxyCRG</li> </ul>		<ul style="list-style-type: none"> <li>• Neo/ICU Defaults</li> <li>• Switchable unit types, ICU/OR</li> <li>• 2 Invasive Pressures</li> <li>• 2 Temperatures &amp; DiffT</li> <li>• Split Screen Trends, oxyCRG, tcGas supported</li> <li>• No ST</li> </ul>	
EEPROM Part Numbers	Option	EEPROM Part Numbers	Option
M1204-10401	Standard	M1204-10441	Standard
M1204-10402	ST 2.0 (opt. C10)	M1204-10443	Delete ADM
M1204-10403	No ST, Delete ADM	M1204-10444	Delete ADM, Delete 4th Wave
M1204-10404	No ST, Delete ADM, Delete 4th Wave		
M1204-10405	ST 2.0, Delete ADM		
M1204-10406	ST 2.0, Delete ADM, Delete 4th Wave		

<b>EEPROM Configurations (Application Bundles) -- Revision E.00.07 (contd.)</b>			
<b>Anesthesia (H01)</b>		<b>Anesthesia (H03)</b>	
<ul style="list-style-type: none"> <li>• Special OR Config Set Defaults - OR Unit Type Only</li> <li>• 2 Invasive Pressures</li> <li>• 2 Temperatures &amp; DiffT</li> <li>• RS232 (J13 option standard)</li> <li>• No AGM, tcGas or oxyCRG</li> <li>• Unit type not switchable, always OR</li> <li>• Split Screen Trends</li> </ul>		<ul style="list-style-type: none"> <li>• Special OR Config Set Defaults - OR Unit Type Only</li> <li>• 2 Invasive Pressures</li> <li>• 1 Temperature &amp; NO DiffT</li> <li>• AGM support via RS232 (J13 option standard)</li> <li>• No tcGas, oxyCRG, CO<sub>2</sub> or ssCO<sub>2</sub></li> <li>• Unit type not switchable, always OR</li> <li>• No Split Screen Trends or VueLink A</li> </ul>	
EEPROM Part Numbers	Option	EEPROM Part Numbers	Option
M1204-10421	Standard	M1204-10461	Standard
M1204-10422	ST 2.0	M1204-10462	ST 2.0
M1204-10423	No ST, Delete ADM	M1204-10463	No ST, Delete ADM
M1204-10424	No ST, Delete ADM, Delete 4th Wave	M1204-10465	ST 2.0, Delete ADM
M1204-10425	ST 2.0, Delete ADM		
M1204-10426	ST 2.0, Delete ADM, Delete 4th Wave		
<p>All versions of V24 will support the following features:</p> <ul style="list-style-type: none"> <li>• New SpO<sub>2</sub> sensor support</li> <li>• SDN &amp; Data Transfer</li> <li>• French Homologation switchable</li> <li>• Respiration On/Off in Config. Mode</li> <li>• Patient Category Switchable (Adult, Pedi, Neo)</li> <li>• VueLink (except for Delete ADM options)</li> <li>• Local Printer via RS232 (requires J13 option)</li> </ul>			

## Performing EEPROM Cloning

You can use this function to copy EEPROM configurations from one unit to another, rather than program settings individually for each monitor.

From the Monitor Setup screen, press the **[EEPROM Cloning]** softkey to display the EEPROM Cloning screen shown below. You can use this screen to perform two separate operations:

- a. To *read* user settings from the monitor to the programming tool, for use in cloning other monitors.
- b. To *program* user settings from the programming tool onto a V24/V26 Series monitor during cloning operations.

### To Read Settings to the Tool

Press **Read Settings** followed by **[Confirm]** to store the monitor's user settings on the programming tool. The message... Reading EEPROM is displayed, followed by the message... Settings stored in local memory when the read process is complete

### To Program Settings to the Monitor

Press **Program Settings** followed by **[Confirm]** to program the monitor with the configuration settings from the programming tool. The message... EEPROM programming in progress is displayed, followed by the message... Programming done when the cloning process is complete.

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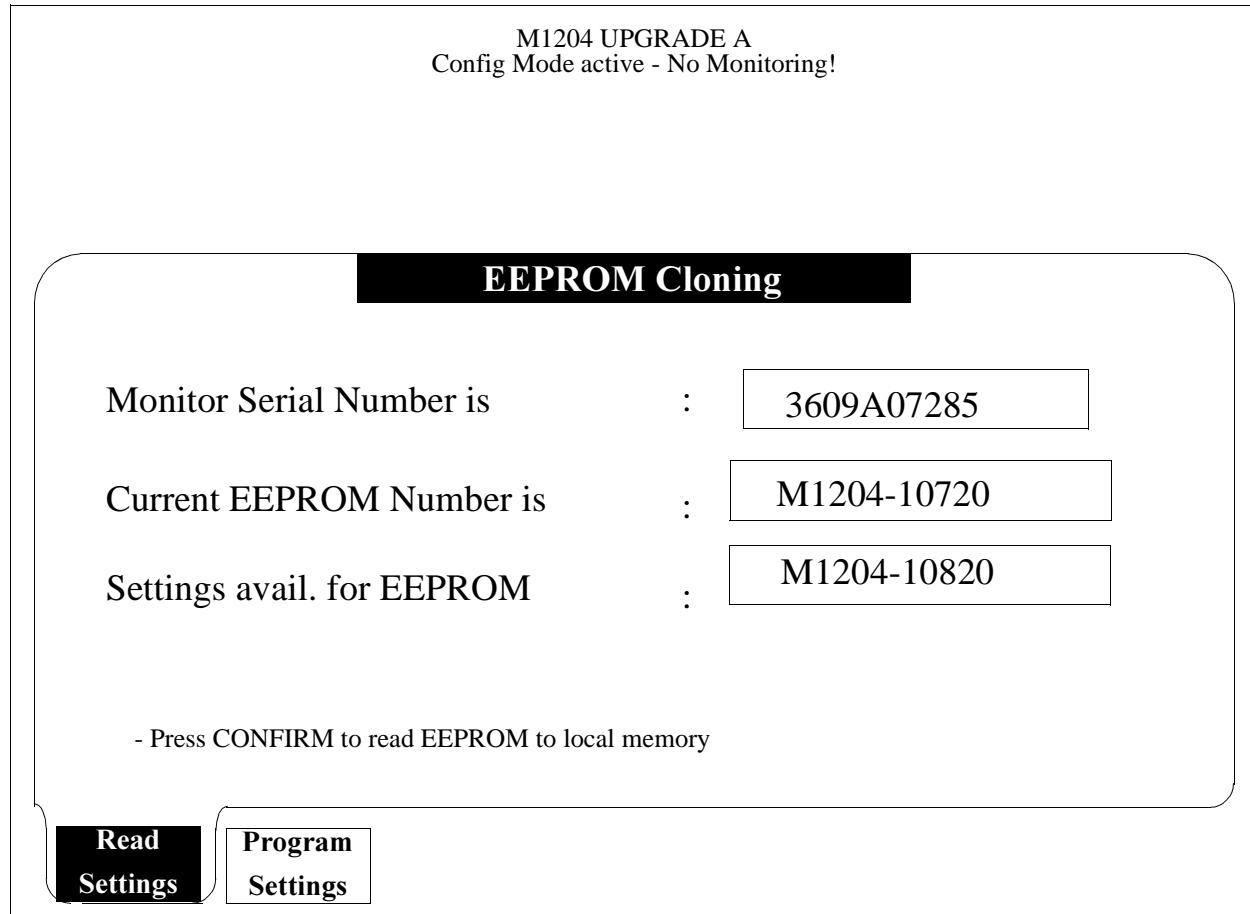
#### NOTES

When you have completed the cloning process, review the displayed information to ensure that the correct EEPROM configuration has been programmed.

The EEPROM contents are stored in the programming tool, *not* on the flash card.

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After cloning operations, perform the “Performance Assurance Test” indicated in this chapter.



**Figure 2-8 EEPROM Cloning Screen**

## EEPROM Upgrades Between Application Bundles

The following does **NOT** apply to CPC Tool programming cards designated for “Agilent use only”.

With Software Release E, it is possible to reprogram the EEPROM to change the instrument configuration from any one of four application bundles to any other. This provides maximum flexibility in how the V24/V26 Series can be utilized.

With Software Release A.0/B.0/C.0, it is possible to reprogram the EEPROM to change the instrument configuration from any one of fifteen application bundles to any other. This provides maximum flexibility in how the instrument can be utilized.

If you upgrade from a previous release to Release C.0 with the restricted flashcard, you have to do a default upgrade first. If another bundle is required you can change to it in a second step.

DIP switches 2-5 control what default EEPROM upgrade is offered. After upgrading from Revision C.xx.xx to Rev. E.00.07, from Rev. C to Rel. C.0, or from Rel. E to Rel. C.0, you can change to another application bundle by powering down the instrument, selecting the appropriate DIP switch setting, powering back up, and completing the default upgrade offered. DIP switch settings and their effect are defined below:

### DIP Switch Positions for Upgrades in Rel. C.0

**Table 1-7 DIP Switch Positions for Upgrades in Rel. C.0**

Upgrade to	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	Index
Default	CLOSE	0							
H06	CLOSE	OPEN	CLOSE	CLOSE	CLOSE	CLOSE	CLOSE	CLOSE	1
H07	CLOSE	OPEN	CLOSE	CLOSE	CLOSE	CLOSE	OPEN	CLOSE	2
H24	CLOSE	OPEN	CLOSE	CLOSE	CLOSE	OPEN	CLOSE	CLOSE	3
H25	CLOSE	OPEN	CLOSE	CLOSE	OPEN	CLOSE	CLOSE	CLOSE	4
H26	CLOSE	OPEN	CLOSE	OPEN	CLOSE	CLOSE	CLOSE	CLOSE	5
H34	CLOSE	OPEN	OPEN	CLOSE	CLOSE	CLOSE	CLOSE	CLOSE	6
H35	CLOSE	CLOSE	OPEN	CLOSE	CLOSE	CLOSE	OPEN	CLOSE	7
H36	CLOSE	CLOSE	OPEN	CLOSE	CLOSE	OPEN	CLOSE	CLOSE	8
H41	CLOSE	CLOSE	OPEN	CLOSE	OPEN	CLOSE	CLOSE	CLOSE	9
H42	CLOSE	CLOSE	OPEN	OPEN	CLOSE	CLOSE	CLOSE	CLOSE	10

**DIP Switch Positions for Upgrades in Rel. A.0/B.0****Table 1-8 DIP Switch Positions for Upgrades in Rel. A.0/B.0**

<b>Upgrade to</b>	<b>SW1</b>	<b>SW2</b>	<b>SW3</b>	<b>SW4</b>	<b>SW5</b>	<b>SW6</b>	<b>SW7</b>	<b>SW8</b>	<b>Index</b>
Default									0
H04	CLOSE	1							
H05	CLOSE	OPEN	CLOSE	CLOSE	CLOSE	CLOSE	OPEN	CLOSE	2
H06	CLOSE	OPEN	CLOSE	CLOSE	CLOSE	OPEN	CLOSE	CLOSE	3
H07	CLOSE	OPEN	CLOSE	CLOSE	OPEN	CLOSE	CLOSE	CLOSE	4
H08	CLOSE	OPEN	CLOSE	OPEN	CLOSE	CLOSE	CLOSE	CLOSE	5
H09	CLOSE	OPEN	OPEN	CLOSE	CLOSE	CLOSE	CLOSE	CLOSE	6
H14	CLOSE	CLOSE	OPEN	CLOSE	CLOSE	CLOSE	CLOSE	CLOSE	7
H15	CLOSE	CLOSE	OPEN	CLOSE	CLOSE	CLOSE	OPEN	CLOSE	8
H16	CLOSE	CLOSE	OPEN	CLOSE	CLOSE	OPEN	CLOSE	CLOSE	9
H24	CLOSE	CLOSE	CLOSE	OPEN	CLOSE	CLOSE	CLOSE	CLOSE	10
H25	CLOSE	CLOSE	CLOSE	OPEN	CLOSE	CLOSE	OPEN	CLOSE	11
H26	CLOSE	CLOSE	CLOSE	OPEN	CLOSE	OPEN	CLOSE	CLOSE	12
H34	CLOSE	CLOSE	CLOSE	CLOSE	OPEN	CLOSE	CLOSE	CLOSE	13
H35	CLOSE	CLOSE	CLOSE	CLOSE	OPEN	CLOSE	OPEN	CLOSE	14
H36	CLOSE	CLOSE	CLOSE	CLOSE	OPEN	OPEN	CLOSE	CLOSE	15

**DIP Switch Settings (software Release E required)****Table 1-9 DIP Switch Settings (software Release E required)**

Switch Position	Application Bundle
(ALL CLOSED)	(NO CHANGE)
SW2 OPEN. All others closed	Standard Configuration
SW3 OPEN All others closed	Anesthesia (H01)
SW4 OPEN All others closed	Neonatal (H02)
SW5 OPEN All others closed	Anesthesia with Agilent AGM Compatibility (H03)

---

**NOTE** DIP switch settings above do not have any effect when using a CPC programming card designated for “Agilent use only”.

---

**NOTE** During the upgrade process, only one switch can be in the OPEN position.

The EEPROM can be reprogrammed to change from one application bundle to another with the following restrictions:

- 1 Features cannot be added that were not already present (e.g., ST, Advanced Data Management). Features that require copyrighted software can only be added by purchasing an upgrade and can only be installed by Agilent-authorized personnel.
- 2 If any bundle with ST capability is changed to a Neonatal bundle, which does not support ST, then ST capability will be lost permanently. The ST feature can then only be added back by Agilent-authorized personnel.

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**NOTE** For further information on what capability each application bundle offers, reference the Technical Data Sheet (TDS) for the Agilent V24/V26 Series, Release A.0.

# Chapter 3 Troubleshooting the Agilent V24/V26 Series

## Objective

After reading this chapter, you will be able to diagnose and isolate hardware failures at the level of the field-replaceable part.

Use this chapter when you suspect you have a problem with your Agilent Model V24/V26, or when you are referred to this module from another procedure.

If your instrument(s) are under the 5 Year Rapid Repair Warranty Service (U.S. only), you can determine if a failure has occurred by referring to the troubleshooting table under “Isolating and Solving Instrument Problems”. You may also use sections, “Check for Obvious Problems”, and “Checks before opening the instrument” to further identify instrument problems.

## In this chapter

This chapter provides the following:

- Tables that list instrument symptoms, cause, and remedy for instrument faults.
- Techniques for troubleshooting the instrument before you disassemble it.
- Checks you can make to isolate problems to replaceable parts, including, Power Supply, System Board, Display Panel, Display Adapter, and Keypad.

Topics in this Chapter	See Page
<b>Part 1. Isolating and Solving Instrument Problems</b>	3-2
Troubleshooting Checklists	3-5
Check for Obvious Problems	3-5
Checks before opening the instrument	3-5
Isolating problems to the correct subassembly	3-8
Monochrome Flat Panel	3-10
Color Flat Panel	3-11

## Isolating and Solving Instrument Problems

You can use the following table to isolate and solve problems which may occur in the instrument.

**Table 3-1. Symptom Related Troubleshooting Table**

Symptoms	Cause of Failure	Remedy
<b>System related problems</b>		
Unable to upgrade the instrument using CPC Programming Tool	Power was left on the instrument when the CPC Programming Tool was installed causing the interface to fail.	Replace the System Board. Connect the service tool to the instrument only when the instrument is powered down.
Cannot send data on the SDN.  Cannot send message to Central Station.  Failure message displayed on the Central Station.	Defective SDN circuitry.  SDN cable assembly disconnected or broken.	Replace System Board.  Replace SDN cable assembly  (If you have the SDN Daughter Board, refer to Appendix A)
Display goes blank and error message indicates “Front End Link protocol problem”	The 10 MHz system clock fails causing the instrument to crash. System Board failure.	Replace System Board.
No marker pulse on screen.  Out of sync ECG Analog Output	ECG Analog Output is defective.  Defib sync input circuit is defective.	Replace System Board.
Incorrect Time and Date.  Invalid data stored showing wrong times for data.  Time and date display shows 1987 date.	The instrument’s real-time clock is defective.	Power on for a few minutes and reset the time and date.  Replace System Board.
Cannot re-program the time and date correctly	Defective System Board.	Replace the System Board.
<b>Power Supply related problems</b>		
“sync output not available” displayed on the screen.  Unable to monitor patient.  Green LED for 60 V not lit on power supply.	No +60V from Power Supply	Replace Power Supply  Replace 60V cable  Replace Plug-in Rack Cable  Replace Plug-in Rack or Plug-in parameter modules

**Table 3-1. Symptom Related Troubleshooting Table (*Continued*)**

Symptoms	Cause of Failure	Remedy
Display is blank  Power Supply LED is off for 12 volts.  Speaker will not work.	No 12 volts present in the instrument or contrast control not adjusted correctly, or backlight failed.	Adjust monochrome contrast control.  Replace backlight  Replace Power Supply
Patient data is corrupted and instrument stores the corrupted data when a power failure occurs.	Power circuit failure	Replace power supply. Replace System Board
<b>Display and Flat Panel Adapter Board related problems</b>		
Fluid dripping or appearing below instrument.	Flat Panel assembly damaged or cracked.	Replace Flat Panel assembly.
Decrease in light intensity on display	Flat Panel Backlight Tube assembly is worn out.	Replace Flat Panel Backlight tube.
Uneven brightness on display	Reflector film covering mono-chrome Flat Panel Backlight is disturbed or improperly positioned.	Re-position reflector film so that it properly covers backlight.
Blank display screen	Display brightness is reduced when room temperature, or instruments placed near patient monitor, causes the monitor display to overheat.  Flat Panel Data Cable to System Board broken or disconnected  (See also System Board and Power Supply related problems)  Backlight inverter power supply fails.  Contrast or Brightness Control Assembly fails.	Adjust contrast control Instrument should be placed in an environment that does not exceed 40 degrees C or below 5 degrees C.  Replace Flat Panel Data Cable to System Board.   Replace Flat Panel (color) Replace Flat Panel Adapter Board (monochrome)  Replace Contrast or Brightness Control Assembly.
Display waves are “noisy” or not showing a smooth QRS wave	Radio frequency interference (RFI) from other instruments such as ultrasound, ESU, Defib, or telemetry is causing a noisy waveforms	Turn off or move away the instrument causing RFI problems from the monitor.

**Table 3-1. Symptom Related Troubleshooting Table (Continued)**

Symptoms	Cause of Failure	Remedy
Contrast or Brightness control knob does not adjust display contrast or intensity	Voltage control in Flat Panel Assembly fails.  Contrast or Brightness Control Assembly fails.	Replace Flat Panel Adapter Board (monochrome)  Replace Flat Panel (color)  Replace Contrast or Brightness Control Assembly.  Instrument should be placed in an environment that does not exceed 40 degrees C. or below 5 degrees C.
<b>Keypad related problems</b>		
Keypad or mainframe housing discolored, cracked or surface is deformed.	Cleaning agents, abrasive material, or strong solvents were used to clean the instrument.	Replace Keypad or mainframe housing and clean the instrument in the future with only isopropyl alcohol. Wipe cleaning agents off surfaces immediately.
Lack of user control of display.  LEDs on Keypad fail to work.	Keypad fails  Cable, Keypad to System Board disconnected or broken  Defective System Board.	Replace Keypad  Replace Keypad to System Board cable.  Replace System Board.
<b>Plug-in Rack related problems</b>		
Plug-in Rack falls from the wall mount	Rack mounted vertically or other improper mounting	Plug-in Rack should be mounted horizontally.
Loose handles on 8-Slot Plug-in Rack	Plug-in Rack is damaged	Replace Plug-in Rack
<b>Parameter Module related problems</b>		
No ECG data or waveform displayed when both defib sync and balloon pump are done together.	2-circuit cable used in a 3-circuit ECG output jack.	Use a bud box when setting up ECG.
Refer to troubleshooting section for individual parameter modules described in Chapter 5.		
<b>Audio Speaker Problems</b>		
“Buzzing” noise accompanying alarm, INOP, or QRS sound.	Speaker mounting problem, e.g. becomes ajar due to being dropped.	Mount speaker properly or replace
No audio alarms.  Speaker will not work.	Speaker has failed or broken wire to speaker.  Defective Audio Circuit  Power supply 12-volt source fails	Replace speaker.  Replace System Board  Replace Power Supply.
“Buzzing” noise in instrument.	Defective Audio Circuit.  Defective Power Supply.	Replace System Board.  Replace Power Supply.

## Troubleshooting Checklists

### Check for Obvious Problems

When first troubleshooting the instrument, check for obvious problems by answering basic questions such as:

- 1** If it is a battery model (V24CT/V26CT), are batteries installed?
- 2** Power switch is turned on?
- 3** AC power cord connected to instrument and plugged into AC wall outlet?
- 4** Circuit breakers are working properly in circuit breaker panel and power is available at wall outlet?
- 5** Cable connecting the rack to the mainframe inserted properly?
- 6** SDN cable is properly connected to back of instrument?

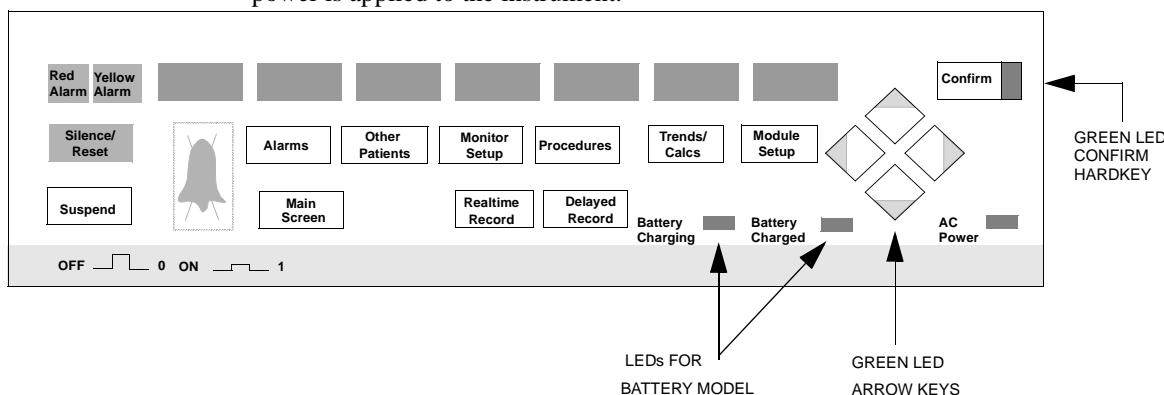
### Checks before opening the instrument

You can isolate many problems by observing several indicators on the instrument before you are required to open the instrument. The following sequence of steps will identify these key indicators when you begin to troubleshoot the instrument.

When power is applied to the instrument and the power switch is on, observe the following:

- 1** The backlight tube lights the Flat Panel display.  
\_\_\_\_ Indicates AC power is present.
- 2** If battery model, battery charge indicators on or flashing.  
\_\_\_\_ Indicates batteries are present and capacity of batteries.  
**Note:** If no battery indicators lights are present, see “Battery Problems” on page 14.
- 3** Error messages appear on the screen.  
\_\_\_\_ Error messages indicate either software or hardware fault has occurred. See Error Codes in this chapter for details.
- 4** Contrast (Model V24) or Brightness (Model V24C/V26C/V24CT/V26CT) adjusted properly. Try an initial setting about mid-rotation of the adjustment knob.

- 5** Green LEDs on the keypad (4 arrow and Confirm keys) are on momentarily when power is applied to the instrument.



**Figure 3-1 Keypad Green LEDs (Battery model shown)**

- 6** There are 3 green LEDs on the power supply which may be observed by looking through the air vents on the left side of the instrument. With power applied, during normal system operation, all 3 LEDs should be on.

For the battery model, follow the right-hand column in the table. Otherwise follow the Leviathan column.

**Table 8-1**

Models V24, V24C, V26C	Model V24CT/V26CT (Battery version)
<p><b>Note:</b> The Model V24 (monochrome) uses power supply M1204-63000 (option #030). The Model V24C/V26C (color) uses power supply M1204-63000 (option #031). The option number is on the mainframe serial number label on the outside of the instrument.</p> <p><b>Figure 3-2. View of Power Supply Green LEDs Model V24 and V24C/V26C</b></p>	<p><b>Note:</b> The Model V24CT/V26CT (battery) uses the power supply M1204-61086. The option number is on the mainframe serial number label on the outside of the instrument.</p> <p><b>Figure 3-3. View of Power Supply Green LEDs Model V24CT/V26CT</b></p>

**Table 8-1**

<b>Models V24, V24C, V26C</b>	<b>Model V24CT/V26CT (Battery version)</b>
The location of the +5VDC, +12VDC, and +60VDC LEDs is illustrated. It is approximately the same for the Models V24 and V24C/V26C.	<p>The location of the +18VDC, +5VDC, and +12/60VDC LEDs is illustrated. The Model V24CT/V26CT uses the:</p> <ul style="list-style-type: none"> <li>• 18VDC LED for the battery charger</li> <li>• 5VDC LED for the system board</li> <li>• 12VDC LED for defib/sync, audio, and backlight</li> </ul>

**60V LED - 60VLED** operation is the same for both power supplies. 60V is used by the plug-in rack.

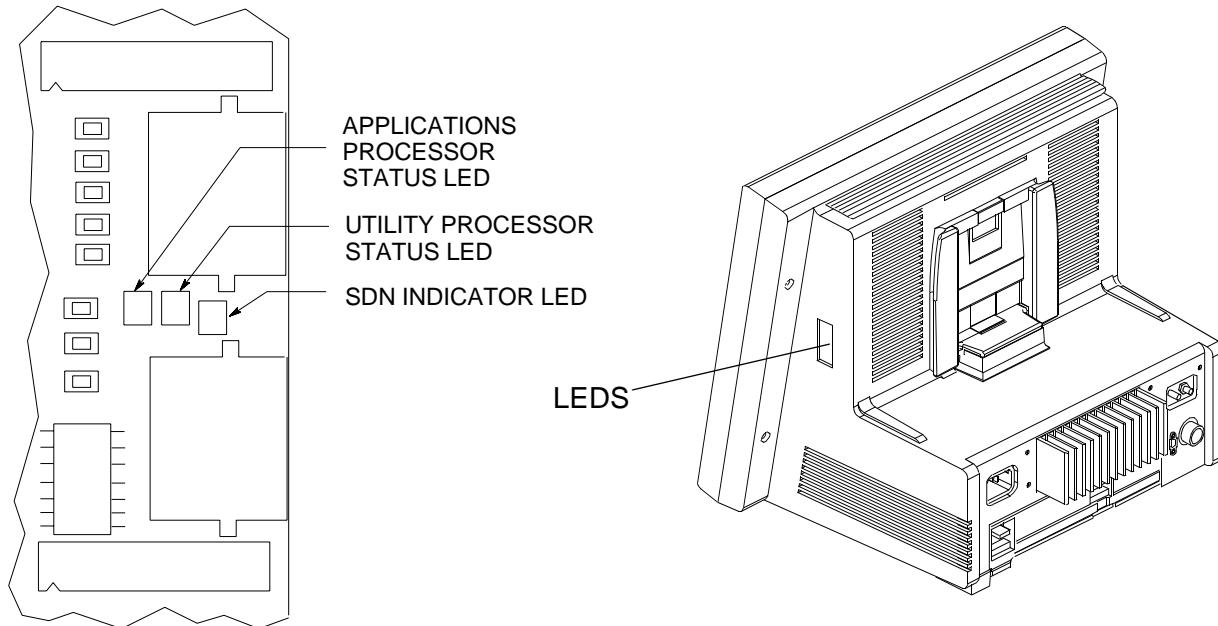
— If only the 60V LED is out or flashing, unplug the rack from the monitor. If it is still out or flashing, then this indicates a power supply, internal 60V cable, or connector problem.

— If the 60V LED appears on steady with the rack unplugged, there may be a short circuit in the plug-in rack, satellite rack cable, or parameter modules.

If there are any other abnormal green power supply LED indications, proceed to “*Isolating Problems to the Correct Subassembly*”.

7 There are 3 small rectangular red LEDs on the System Board (see figure) which indicate if there is a fault in the Application Processor, Utility Processor, or SDN subsystem. They can be viewed through the service port opening and are located between the upper and lower service ports.

— Table 3-2 describes fault conditions and possible causes.



**Figure 3-4. Location of Red LEDs on System Board (shown on a CT model)**

**Table 3-2. LED Troubleshooting**

<b>System Board LED</b>	<b>Condition and description</b>	<b>Remedy</b>
SDN Functionality LED	Should be OFF when operating properly.  If ON, indicates reset error in SDN circuitry	Replace System Board if LED is ON.  (If you have the SDN Daughter Board, refer to Appendix A.)
Application Processor LED	Should BLINK on and off when operating properly.  If ON continually, indicates system error.  If slow blink (every 2 seconds) indicates System Board is resetting	Replace System Board if LED is ON.
Utility Processor LED	Should BLINK on and off when operating properly.  If ON continually, indicates system error.  If slow blink (every 2 seconds) indicates System Board is resetting	Replace System Board if LED is ON.
All 3 LEDs	If all 3 LEDs are off, indicates no power to the System Board	Check power supply and cabling.

\_\_\_\_\_ If power switch will not click on or will not stay depressed, then power switch assembly is defective and should be replaced.

### Isolating problems to the correct subassembly

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**WARNING**


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**High Voltage - Voltages dangerous to life are present in the instrument. Do not perform any disassembly procedures (other than parameter module removal) with power applied to the instrument. Failure to adhere to this warning could cause serious injury or death.**

If problems are not isolated from observing LEDs, keyboard lights, error codes, and so on, then the next level of troubleshooting requires that you check each of the major subassemblies. In the case of the CT model, the following checks assume power is applied to the instrument and the power switch is on.

Remove the Front Housing to troubleshoot the unit and check the following:

**1 Check power supply LEDs.**

\_\_\_\_\_ All three green LEDs should be on with power applied.

\_\_\_\_\_ For the CT model, if one or more of the LEDs are not illuminated see “Blown Fuses (Model V24CT/V26CT)” on page 11.

**2 Check 60V LED.**

\_\_\_ If only the 60V LED is still out or flashing after unplugging the rack from the monitor, then this indicates a power supply, internal 60V cable, or connector problem.

\_\_\_ Disconnect the 60V power supply to the System Board by disconnecting the 60V cable from the System Board. If it turns on, this indicates a possible short in the System Board or connector.

\_\_\_ For the CT model, if the rightmost LED (60V) is flashing once per second there is a problem with one or more of the parameter module racks connected to the instrument. See “Parameter Rack/Module Fault (Model V24CT/V26CT)” on page 14.

**3 Check 5V/12V LEDs**

**5V/12V LEDs** - operation differs depending on the type of power supply. 5V/12V is used in the System Board, Flat Panel assembly circuitry, and power supply.

**M1204-60060 power supply:** the 5V/12V LEDs can either flash (attempting to restart) or go out due to an overload or short circuit.

\_\_\_ Disconnect the power supply to System Board 5V/12V ribbon cable and observe the 5V and 12V LEDs.

\_\_\_ If the 5V or 12V LEDs remain off, this indicates a Power Supply problem.

\_\_\_ If the 5V LED turns on or stops flashing, this indicates a short after the power supply (e.g., System Board). If the 12V LED turns on or stops flashing, this also indicates a short after the power supply (e.g., System Board, Flat Panel circuitry).

**M1204-63000 power supply:** the 5V/12V LEDs will go out due to an overload or short circuit. The LEDs will not flash. The power supply will not restart, nor will the 5V/12V LEDs turn on until the AC power is turned off, the fault is removed, and the AC power is cycled back on again after having been off for approximately 20-30 seconds.

**4 Check the Flat Panel Assembly and Backlight**

\_\_\_ If the 12V LED light is on, this indicates the power supply should be providing power to the Flat Panel backlight.

\_\_\_ If contrast (Model V24) or brightness (Model V24C/V26C/V24CT/V26CT) adjustment fails to work properly, check the following:

\_\_\_ Potentiometer assembly

\_\_\_ Flat Panel Adapter Board (**monochrome**)

\_\_\_ Ribbon cable connecting the CDCI Board to the Flat Panel Adapter Board (**color**)

\_\_\_ Flat Panel cabling

\_\_\_ Flat Panel assembly

- 5** For the CT model only, check battery operation by disconnecting the AC power cord from the AC power source.

\_\_\_\_\_The leftmost LED on the power supply should go out after a few seconds. The other two LEDs to the right of it should remain illuminated.

\_\_\_\_\_The battery fuel gauge should display on the screen indicating the capacity of the batteries. If the battery fuel gauge indicates that the batteries are discharged, reconnect the AC power cord to recharge batteries or replace with fully charged batteries.

\_\_\_\_\_If the Flat Panel display dies when AC power cord is removed, the batteries are either not present or are discharged. Check to see if the batteries are present. If the batteries are not present, install batteries. If batteries are present, reconnect the AC power cord to recharge batteries or replace with fully charged batteries. See “Replacing Lead-Acid Batteries” on page 9-18 for information on installing batteries.

\_\_\_\_\_If charged batteries are installed but the battery indicator does not appear on the display, the mechanical contact that drives the indicator is faulty. See “Battery Problems” on page 14 or replace the power supply assembly to correct the fault. See “Removing the Power Supply Assembly” on page -10 for information on replacing the power supply assembly.

### **Monochrome Flat Panel**

\_\_\_\_\_If the **monochrome** Flat Panel backlight fails to light, the source of the problem may be the cable connecting the System Board to the Flat Panel Adapter Board, Flat Panel Adapter Board, cable connecting Flat Panel Adapter Board to Flat Panel, or the backlight.

\_\_\_\_\_If the monochrome screen is either all white or deep blue, and doesn't change with movement of the contrast control thumbwheel, the problem could be failure of the Flat Panel contrast circuit on the Flat Panel Adapter Board, the contrast control potentiometer, or cable.

\_\_\_\_\_If the monochrome screen can be adjusted in brightness by the contrast control, but there is no display, then the System Board, Flat Panel assembly, or possibly cables could be defective.

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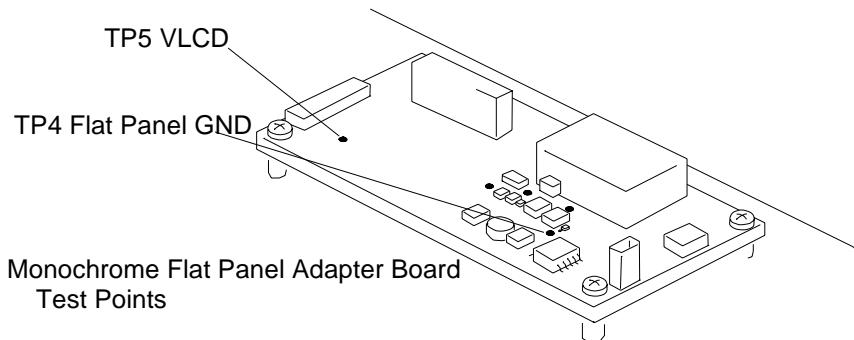
#### **NOTE**

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The backlight inverter circuitry is located on the monochrome Flat Panel Adapter Board.

## To Check Monochrome Flat Panel Adapter Board

- 1 Attach a voltmeter to two test points where shown.



- 2 Unplug Flat Panel cable.
- 3 Turn contrast knob. The voltage reading should indicate a range of between -12 and -21 volts DC (approximate) as you adjust the potentiometer. If you cannot control the voltage with the contrast knob, replace the Flat Panel Adapter Board or contrast control assembly.
- 4 If you can control the voltage with the contrast control, replace the Flat Panel assembly.

## Color Flat Panel

—If the **color** Flat Panel backlight fails to light, the source of the problem may be the cable connecting the System Board to the CDCI Board or in the later version to the Display Driver Board, cable connecting the CDCI Board to the Flat Panel Adapter Board, cable connecting the Flat Panel Adapter Board to the Flat Panel, Converter cable, Converter Board, the Flat Panel assembly, or the backlight.

—If the color Flat Panel screen appears totally black, try viewing it obliquely from above a perpendicular aspect: the screen will appear dark blue if the backlight is on.

—If the color Flat Panel backlight is working, but the screen is blank, then the power supply (+5V), System Board, DSPC (Display Controller) Board or the Display Driver Board of the new version, the Flat Panel assembly or possibly cables could be defective.

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**NOTE** For the old color display, the backlight inverter circuitry is internal to the Color Flat Panel display assembly.

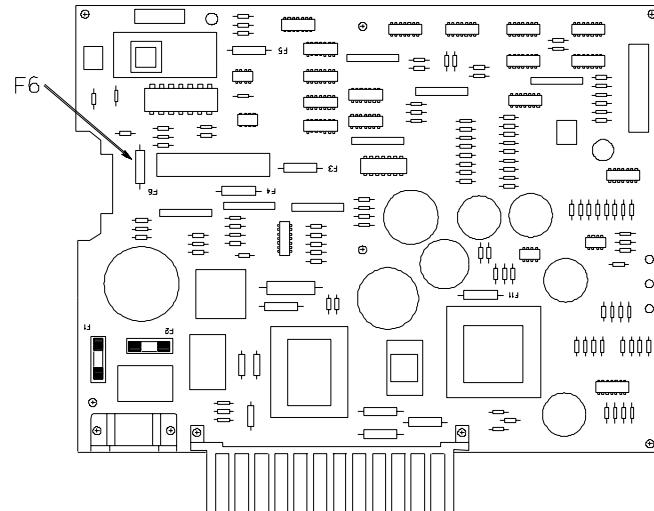
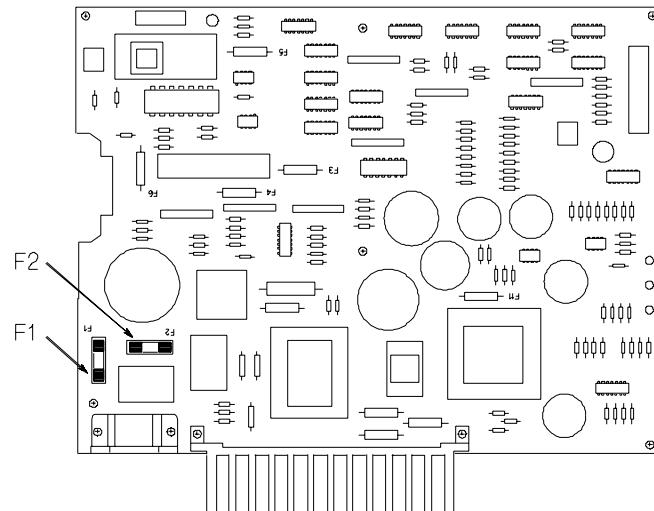
For the newer color displays, the Converter Board is located on the Flat Panel display frame.

## Blown Fuses (Model V24CT/V26CT)

Use this section if any of the power status LEDs on the power supply assembly (visible through the LEFT air vent) that should be illuminated per the source power are extinguished, or if a blown fuse is suspected as the source of the problem.

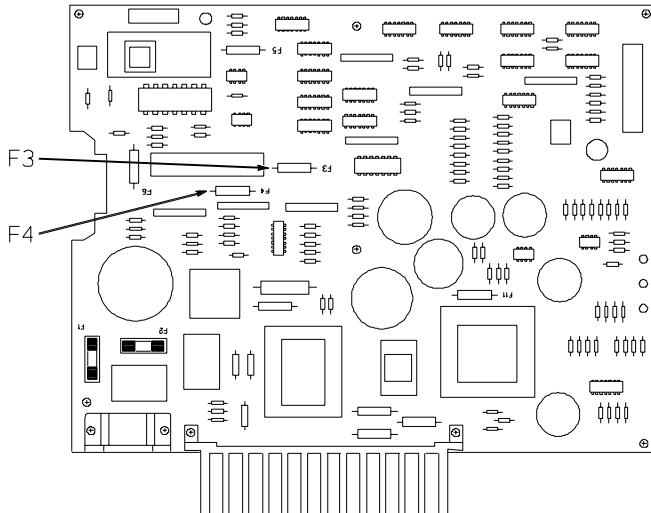
- 1 Turn off power.

- 2 Remove the Front Housing (see “Removing the Front Housing Assembly” on page 9-2).



- 3 If the LEFTMOST LED (AC Power) was extinguished, check fuses F1 and F2 (AC fuses), and F6 (18V fuse). Fuses F1 and F2 can be checked visually. Fuse F6 must be checked with an ohmmeter and is considered good if it reads a short. If the fuses are good, verify that the monitor was plugged into a sufficient power source. If it was, replace the power supply assembly (see “Chapter 8 Repairing the Agilent Model V24CT/V26CT”).
- 4 If either F1 or F2 are blown, replace them (see Chapter 11 for part number).

- 5** Reapply power to the monitor and see that fuses do not blow. If the fuses blow again, replace the Power Supply Assembly (see “Chapter 8 Repairing the Agilent Model V24CT/V26CT”).



- 6** If the MIDDLE LED (+5Vdc logic supply to System Board) and the RIGHTMOST LED (12V) are extinguished.
- Turn off power.
  - Disconnect the CPU/Power Board cable from the power supply assembly.
  - Reapply power.
  - Check LEDs. If on, replace the System Board. If off check and replace power switch assembly or power supply assembly if needed.
- 7** If only the RIGHTMOST LED (+12V/60V) was extinguished and the MIDDLE LED is on, look to see if message “only 6 slots may be occupied by modules” is displayed on screen. If the message is displayed, refer to “Parameter Rack/Module Fault (Model V24CT/V26CT)” on page 14. If the message is not displayed perform the following steps:
- Turn off power.
  - Disconnect the CPU/Power Board cable from the power supply assembly.
  - Reapply power.
  - Check LED. If on, replace the System Board. If off, check fuse F3. If it is good, replace the Power Supply Assembly (see “Chapter 8 Repairing the Agilent Model V24CT/V26CT”). If F3 is blown, replace it. Reapply power to the monitor and observe the fuse does not blow.

- 8 If only the MIDDLE LED is extinguished, replace fuse F4.

## Parameter Rack/Module Fault (Model V24CT/V26CT)

Use this section if an error message stating “only 6 slots may be occupied by modules” is displayed or if the RIGHTMOST LED on the Power Supply assembly is flashing.

- 1 If the message “only 6 slots may be occupied by modules” is displayed, check the rack connected does not have too many modules plugged into it.
- 2 Disconnect rack to see if LED stops flashing and remains on continuously, and/or the error message goes away. If a faulty rack is identified, reconnect it, and remove the parameter modules from it one at a time to see if a parameter module is causing the problem. If the LED stops flashing when a parameter module is removed, and/or the error message goes away, replace the parameter module. If all of the parameter modules are removed and the symptoms do not change, replace the rack.

## Battery Problems

Use this section when the battery or battery charger circuit are suspected as faulty. For more information refer to “Chapter 8 Testing & Maintaining the Agilent V24/V26 Series”. Perform the following with the power switch off.

- 1 Connect the Model V24CT/V26CT to an AC power source. Observe that the leftmost LED is illuminated. If it is not, refer to “Blown Fuses (Model V24CT/V26CT)” on page 11.

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**NOTE** The next procedure requires the battery charger to be in state 2 of the charging cycle. With discharged batteries, it takes approximately one-and-a-half hours to achieve state 2. With 90% charged batteries, state 2 can be achieved in two minutes.

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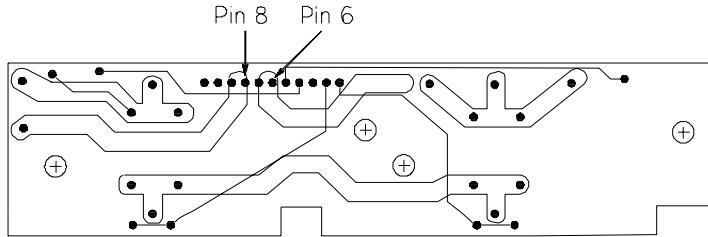
**CAUTION** Do not remove the display assembly with batteries installed. Removing the display assembly with the batteries installed can short the battery contacts together and damage the instrument.

- 2 Measure the battery open circuit voltage by performing the following steps:
  - a Remove the batteries. see “Removing the Lead Acid Batteries” on page 9-5.
  - b Remove the display assembly.
- 3 Insert batteries. Press the power on switch to turn the monitor on. If 90% charged batteries are used, the charger enters state 2 in about 2 minutes. If discharged batteries are used, it will take about one-and-a-half hours to enter state 2. If discharged batteries are being used, observe the LEDs on the front panel go through a sequence as indicated by the following table. If no indicator lights appear on the front panel, see Step 5 on 3-16.

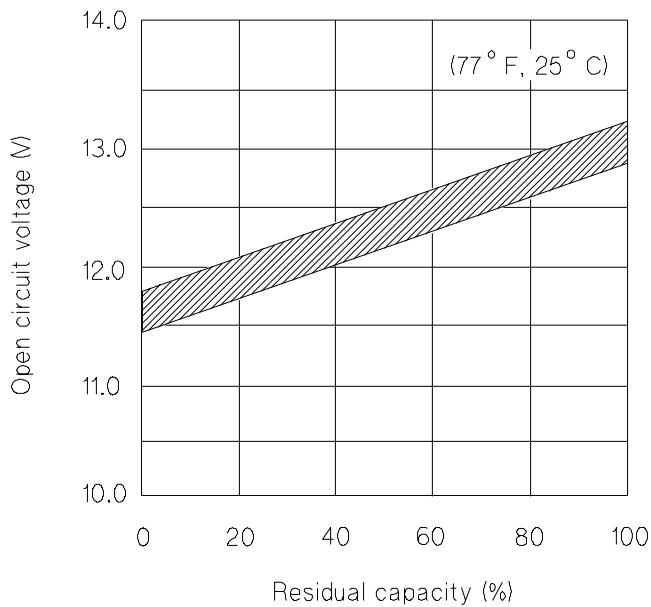
**Table 4-3. LED Pattern During Charge Sequence**

Residual Capacity	Charging LED	Charged LED
Up to 40%	Flashing	Off

Residual Capacity	Charging LED	Charged LED
More than 40%, Less than 90%	Steady	Off
More than 90%	Off	Steady

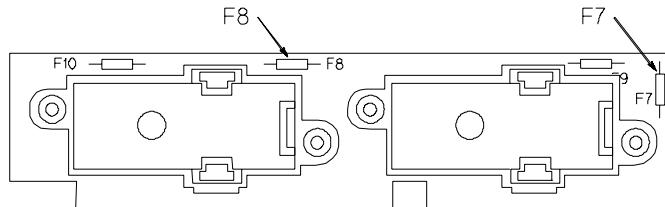


- 4 Use a voltmeter and measure each battery. For battery 1, the battery voltage can be sensed between pin 8 and ground. For battery 2, the voltage can be sensed between pin 6 and ground. The voltage should be 14.7 Vdc. The residual capacity of the batteries can be estimated by measuring the open circuit voltage of the batteries and comparing it to the following figure.



If the batteries discharge much more quickly than expected by the graph, the batteries have exceeded their useful life and should be replaced.

- 5 If the voltage is less than 9 Vdc, the batteries have been over-discharged and the charger cannot be armed. If this is the case, the Charging LED on the front panel will not light when the batteries are being charged. Replace the batteries.
- 6 If the voltage is more than 9 Vdc, but less than 14.7 Vdc, allow some more time for the charger to bring the batteries up to state 2.



- 7 If the voltage is absent, use an ohmmeter to check fuse F7 for battery 1 and F8 for battery 2. If they read anything other than a short, replace the fuses. If the fuses continue to blow, replace the power supply assembly.

# Chapter 4 Using Support Functions

## Objective

This chapter describes how to troubleshoot problems using error codes and other support functions. This chapter shows you:

- How to use the Status Log to check for error codes, and other service information.
- How to interpret error codes and how to use them to isolate faults.

## In this chapter

This chapter describes the following support features available to the Agilent V24/V26 Series:

- Table of error codes and information on how to use them
- Using Service Mode
- Description of the Boot Process

Topics in this Chapter	See Page	Topics in this Chapter	See Page
Error Codes	4-2	Settings Transfer	4-12
Error Code Description	4-2	Setting the Altitude	4-13
Error Code List	4-3	Setting the Date and Time	4-13
System Configuration Problems	4-8	Displaying the Status Log	4-13
Procedures	4-8	To Access Monitor Revisions Screen	4-14
System Hardware/Software Problem/RAM Problem	4-8	Displaying the Software or Hardware Revision	4-14
General Error Code List	4-9	Summary of Power On Modes	4-15
Error Code List for Specific Device IDs Other Than 16400 (4010H)	4-10	Network Test	4-17
Using the Service Mode	4-11	Performing the RS232 Loopback Test	4-21
Accessing Service Mode	4-11	Display Tests	4-23
Facilities Available in the Service Mode	4-11	Description of the Boot Process	4-24
Changing the Global Switches	4-12	Fixing Recorder Problems	4-26
Line Frequency	4-12	Fixing Printing Problems	4-27

## Using Support Functions

### Error Codes

The first line of fault isolation is the **Error Codes**. Whenever one of the subsystems is unable to perform an operation, an error code is generated. Error codes can be for fatal and non-fatal errors. **Fatal** errors are errors which cause the Monitor to re-start. **Non-fatal** errors are general errors that are not significant enough to affect normal Monitor operation.

Error codes can be found in the **Status Log** while in any of the four operating modes. In the Configuration, Demonstration, and Monitoring modes, the Status Log only displays fatal error codes. In the Service Mode, the Status Log displays both fatal and non-fatal error codes with a blank line separating the two.

**If an error occurs when the Monitor is starting up, a start-up error code is generated** and displayed at the top of the screen. Start-up error codes give similar information to the Status Log entries, except the codes are given in hexadecimal notation. Also, when you perform a software upgrade, a fatal error code may appear in the Status Log.

**Table 4-1.Error Code Description**

Field	Description
H, W, C or F	H, W, and C denote fatal errors which have caused a <b>Hot</b> , <b>Warm</b> , or <b>Cold</b> start. F denotes a <b>Fatal</b> error without reference to the type of restart caused.
Subsystem	RACK_IF, for example
Part Number of System Board	M1204-60107 <b>(NOTE:</b> Your system may have a different System Board.)
Device ID Code	The number referring to a hardware device or software module, and used to indicate the location of a fault.
Error code	Number describing the type of fault identified. The error code tables in this module give more details.
Date\Time	Date and time the error occurred.

**Using Error Codes.** This section includes procedures on how to access the Status Log in the various operating modes, and what actions to take when a fatal error is encountered. This module includes error code lists for the errors reported by the Monitor, grouped by **Device ID**, and the recommended course of action for each fault.

**Using the Service Mode.** This section gives you details on how to use the functions of the Service Mode to check the operation of the Monitor and to test specific functions. This section includes a description of the power on modes.

## To Use Error Codes

Access the Status Log:

- 1 From any of the operating modes, press the **Monitor Setup** Hardkey.
- 2 Press the  softkey.
- 3 Use the ARROW keys to move the highlighting to the softkeys that include .
- 4 Press the  softkey. The screen displays the **Status Log**. Once in the Status Log, check it for entries that have an H, W, C, or F entered in their first field. This identifies fatal errors. We are only concerned with fatal errors because these are the errors which are significant enough to affect the Monitor operation. Each fatal error shows you the following:
  - a. The subsystem which has reported the fault,
  - b. The part number of the subsystem,
  - c. The device ID code which indicates the hardware device or software piece which the caused the fault,
  - d. The error code describing the fault identified.
  - e. The date and time the fault occurred.

This is important because the status log contains the fourteen most recent occurring errors, with the most recent errors at the bottom. If you have more than one error message for a single incident, deal with the first occurring error message (error messages are listed chronologically by date and time) before dealing with the others pertaining to the incident. It is a good practice to erase the Status Log after you have dealt with or recorded all the errors shown.

## Using Start-up Error Codes

If your Monitor is re-starting repeatedly, a start-up error code may appear at the top of the screen. The start-up error code gives information similar to that displayed in the status log, except the start-up error codes are listed in hexadecimal notation. These codes are identified by an "H" at the end of the code.

Start-up Error Messages require the same corrective action as the error messages found in the status log. The Error Code Listings at the end of this module contain the hexadecimal equivalent for each error code and device ID.

## Error Code Lists

The first table gives the error code listing for device ID 16400 (4010H). The next table gives the error code listing for all other device error code. Each error code entry provides the following information:

**Status Log Errors** - the decimal number range the error code gives in its status log entry.

**Start-up Error** - the hexadecimal number range of the start up error code.

**Possible Cause** - the possible cause for the error code report.

**Corrective Action** - actions recommended to isolate the fault to a replaceable assembly.

**Table 4-2. Error Code Listing for Device ID 16400**

Status Log Errors	Start-up Errors	Possible Cause	Corrective Action
1 - 99	0001H - 0063H	Hardware test failure in the first boot stage.	RAM problem- refer to the corrective action description in the appropriate section after this table.
100 - 199	0064H - 00C7H	Microprocessor interrupts due to a Hardware or Software problem.	Hardware/Software problem- refer to the corrective action description in the appropriate section after this table.
200	00C8H	MPB chip errors: Can be caused by hardware defects on the indicated CPU as well as hardware defects on any other MPB participant in the system.	Hardware/Software problem- refer to the corrective action description in the appropriate section after this table.
201 - 202	00C9H -00CAH	System configuration problem or invalid contents of the Util CPU EEPROM.	System Configuration problem - refer to the corrective action description in the appropriate section after this table.
203 - 239	00CBH - 00EFH	Same as error 200	Hardware/Software problem- refer to the corrective action description in the appropriate section after this table.
240	00F0H	Message transmission problem.	System configuration problem - refer to the corrective action description in the appropriate section after this table.
241	00F1H	Same as errors 203 - 239.	Hardware/Software problem- refer to the corrective action description in the appropriate section after this table.
242	00F2H	Message transmission problem.	System Configuration problem - refer to the corrective action description in the appropriate section after this table.
243 - 299	00F3H - 012BH	Same as errors 203 - 239.	Hardware/Software problem - refer to the corrective action description in the appropriate section after this table.

**Table 4-2. Error Code Listing for Device ID 16400 (Continued)**

<b>Status Log Errors</b>	<b>Start-up Errors</b>	<b>Possible Cause</b>	<b>Corrective Action</b>
300 - 301	012CH- 012DH	EPROM checksum incorrect.	System Configuration problem - refer to the corrective action description in the appropriate section after this table.
305 - 307	0131H- 0133H	Boot errors - software upgrade problem (for example: Flash Card corrupt). Will only occur when Upgrade Tool connected.	Switch the System off, re-insert the Upgrade Tool and switch the System on again. Replace System Board
310 - 315	0136H- 013BH	EPROM version and EEPROM version not compatible.	System Configuration problem - refer to the corrective action description in the appropriate section after this table.
330, 335	014AH, 014FH	Indicates that System Board does not boot up as required.	Hardware/Software problem - refer to the corrective action description in the appropriate section after this table.
340, 356, 370	0154H, 0164H, 0172H	Indication of communication problems between the APP_CPU and another MPB participant.	Hardware/Software problem - refer to the corrective action description in the appropriate section after this table.
380	017CH	Firmware revision is incompatible with current Software revision.	Configuration problem - refer to the corrective action description in the appropriate section after this table.
390	0186H	Indication of a communication problem between a CPU and another MPB participant.	Hardware/Software problem - refer to the corrective action description in the appropriate section after this table.
391, 392	0187H, 0188H	Out of memory.	System Configuration problem - refer to the corrective action description in the appropriate section after this table.
400 - 409	0190H- 0199H	Out of memory.	System Configuration problem - refer to the corrective action description in the appropriate section after this table.
410 - 419	019AH- 01A3H	Missing file errors	System Configuration problem - refer to the corrective action description in the appropriate section after this table.
420 - 449	01A4H- 01C1H	Utility CPU / EEPROM error	System Configuration problem - refer to the corrective action description in the appropriate section after this table.
450		The VUF version of the utility processor is not compatible with the application BOOT ROM Utility needs to be upgraded	Reprogram both processors.

**Table 4-2. Error Code Listing for Device ID 16400 (*Continued*)**

<b>Status Log Errors</b>	<b>Start-up Errors</b>	<b>Possible Cause</b>	<b>Corrective Action</b>
450		No response from the utility CPU to a request for the VUF revision	System Configuration problem - refer to the corrective action description in the appropriate section after this table.
500 - 699	01F4H - 02BBH	Software problem	Replace System Board.
700 - 799	02BCH - 031FH	Communication problem between two CPUs	Refer to the System Configuration Problem corrective action description in the appropriate section after this table.  Refer to the Hardware/Software problem corrective action description in the appropriate section after this table.
800 - 899	0320H - 0383H	Configuration problem	System Configuration problem - refer to the corrective action description in the appropriate section after this table.
900 - 914	0384H - 0392H	Something within the System memory has changed unexpectedly. This is usually caused by a RAM problem.	RAM problem - refer to the corrective action description in the appropriate section after this table
915	0393H	One of the CPUs has failed to send a test message to the next CPU.	Replace the System Board
916 - 919	0394H - 0397H	Something within memory has changed unexpectedly (see error range 900-914).	RAM problem - refer to the corrective action description in the appropriate section after this table.
920	0398H	Indicates a missing 32 ms interrupt on the CPU. This could be caused by a poor connection or a failure on the Util CPU.	Replace System Board
921 - 999	0399H - 03E7H	Something within memory has changed unexpectedly (see error range 900-914).	RAM problem - refer to the corrective action description in the appropriate section after this table.
1000 - 1031	03E8H - 0407H	Missing mandatory card	System Configuration problem - refer to the corrective action description in the appropriate section after this table.
1032 - 1063	0407H - 0427H	Wrong boot firmware	System Configuration problem - refer to the corrective action description in the appropriate section after this table.
1064 - 1095	0428H - 0447H	Insufficient MPB RAM on CPU	Hardware/Software problem - refer to the corrective action description in the appropriate section after this table.

**Table 4-2. Error Code Listing for Device ID 16400 (*Continued*)**

<b>Status Log Errors</b>	<b>Start-up Errors</b>	<b>Possible Cause</b>	<b>Corrective Action</b>
1096 - 1127	0448H - 0467H	No Extended Test result due to Hardware problem.	Hardware/Software problem - refer to the corrective action description in the appropriate section after this table
1128 - 1159	0468H - 0487H	Extended Test failed.	Hardware/Software problem - refer to the corrective action description in the appropriate section after this table
1160 - 1191	0488H - 04A7H	RAM Card size not compatible with backplane configuration.	System Configuration problem - refer to the corrective action description in the appropriate section after this table.
1192 - 1223	04A8H - 04C7H	EEPROM configuration of the card is not compatible to the Hardware configuration.	System Configuration problem - refer to the corrective action description in the appropriate section after this table.
1224 - 1255	04C8H - 04E7H	Wrong CPU.	Hardware/Software problem - refer to the corrective action description in the appropriate section after this table.
1256 - 1287	04E8H - 0507H	CPU is too slow.	Hardware/Software problem - refer to the corrective action description in the appropriate section after this table
2110 - 2152	083EH - 0866H	Unreleased Software installed (non-fatal error).	Contact your local response center - install released Software.
2170 - 3300	087AH - 0C54H	Hardware problem.	Exchange the System Board

## **System Configuration Problems**

This section tells you how to troubleshoot configuration problems identified in the error code listing.

### **Procedures**

In general, the procedure for your configuration requires you to perform some visual checks, verify you are operating with the proper software revision for your Monitor, and then perform fault isolation procedures.

1. Verify the correct EEPROM part number by:
  - a. checking the number displayed in the “Monitor Revision” screen or,
  - b. using the cloning tool if the monitor is rebooting continuously or the display is blank.
2. If the part number is correct, reprogram the EEPROM to the factory defaults using the programming tool.
3. If the part number is incorrect, reprogram the Flash EPROM using the Programming Tool.
4. If the preceding actions do not correct the problem replace the System Board.

## **System Hardware/Software Problem/RAM Problem**

This section shows you how to fix problems that are of a hardware\software nature. The procedure for fixing these type of problems differs based on the type of error code received.

### **Procedures**

1. If you get an error code in the Status Log, go to the Service Mode and execute the extended test. If the test identifies a hardware fault, replace the System Board.
2. If the Monitor reboots continuously, perform the following:
  - a. Reprogram the Flash EPROM using the Programming Tool.
  - b. Reprogram the EEPROM.
  - c. If the preceding actions do not correct the problem, replace the System Board.

## General Error Code List

This section lists general error codes that you might see for Device ID codes other than 16400 (4010H). The source of the problem is not dependent on the Device ID

**Table 4-3. Device ID Error Codes**

Error Code Range	Possible Cause	Corrective Action
10000 - 10999 (2710H - 2AF7H)	Software internal warnings.	This is a non fatal error and can be ignored.
11000 -11999 (2AF8H -2EDFH)	Buffered data either lost or corrupted.	Continuous Rebooting: Allow the system to reboot. If the error code recurs, replace the System Board.  <b>During Run-time:</b>  If occurrence is transient, ignore  If error code recurs often, perform the extended test in Service Mode. If the test identifies an error, replace the System Board.
12000 - 12999 (2EE0H - 32C7H)	EEPROM access failure.	Try to reprogram the EEPROM using the cloning tool.  Replace the EEPROM on the System Board.  Replace the System Board.
13000 - 13999 (32C8H - 36AFH)	System internal configuration related errors. This refers to the structure of the various software modules.	The structure of the various software modules cannot be changed in the field. These error codes do not relate to the system field configuration.

## Error Code List for Specific Device IDs Other Than 16400 (4010H)

This section lists error codes with specific Device IDs other than 16400 (4010H). The source of the fault, and meaning of the error codes listed can only be determined by the identification of the error code's specific Device ID.

**Table 4-4. Error Codes for Device IDs other than 16400**

Device ID	Error Codes	Possible cause - Fault	Corrective Action
8197 (2005H)	18995 (4A33H)	SDN communication problem (could be caused by temporary SCC power failure).	Check SDN connection- Restart the Monitor after reconnecting. Check/exchange SDN cable. Check/exchange System Board
17000 (4268H)	46146 (B442H)	Non-fatal error reported by the recorder module.	* Ensure that there is paper in the module. * Ensure that the recorder module door is firmly shut.
32709 (7FC5H)	20120 - 20128 (4E98H - 4EADH)	Data Transfer Module.	Troubleshoot Data Transfer Module.
32744 (7FE8H)	21035 (522BH) 21107 (5273H) 24138 (5E4AH)	Internal time handling problem. This error does not imply defective behavior.	Ignore.
32747 (7FEBH)	3733 (0E95H) 11200 (2BC0H) 20004 (4E24H) 20133 (4EA5H)	Internal time handling problem. This error does not imply defective behavior.	Ignore.
32747 (7FEBH)	64026 (FA1AH)	Monitor reboots intermittently.	In Service Mode, execute the extended test. If the test identifies an error, replace the System Board.
32752 (7FF0H)	22300 (571CH)	Monitor reboots intermittently.	Replace the System Board.
32752 (7FF0H)	35841 (8C01H) 36353 (8E01H)	Monitor reboots intermittently.	Replace the Display Controller Board or Display Driver Board.
32753 (7FF1H)	20300 (4F4CH)	Rack_IF communication problem.	Check Rack_IF connection. Replace System Board.
32753 (7FF1H)	50497 (C541H)	SDN communication problem (could be caused by temporary SCC power failure	1. Check SDN connection- Restart the system after reconnecting. 2. Check/exchange SDN cable. 3. Replace System Board.
32766 (7FFE8H)	3212 (0C8CH)	Out of memory.	Replace System Board.
32767 (7FFFH)	90 (005AH)	Internal Software problem.	Ignore.

## Using the Service Mode

### Accessing Service Mode

- 1 Press **Monitor Setup**. The Monitor Setup screen is displayed.
- 2 Press
- 3 Press the arrow key to highlight **Operating Modes**.
- 4 Press the  softkey. The Operating Mode task window will appear.
- 5 To change operating mode, enter the password by **slowly** pressing 14432 softkeys.
- 6 Use the arrow keys or press  softkey.
- 7 Press **Confirm** to switch to Service Mode. The system screen will go blank, the system performs a cold start and switches operating modes.

**NOTE**

When Service Mode is entered or exited, all monitor settings are reset to the user defaults and the database is cleared.

In the Service Mode, the display becomes blank and the message “Service Mode active - NO MONITORING!” appears at the top of the screen.

Press **Monitor Setup** to display the Service Mode task window.

### Facilities Available in the Service Mode

The following facilities are available in Service Mode and are described in the following paragraphs:

- Global Switches, including Line Frequency, Settings Transfer, and Altitude
- Date & Time
- Status Log
- Monitor Revision
- Power On Modes
- Network Test.
- RS 232 Loopback Test
- Display Tests

## Changing the Global Switches

The Global Switches facility can be used to change the global configuration of the system. The global configuration is the same for all configuration sets.

To enter the Global Switches task window:

- 1 Press the **Monitor Setup** hardkey.
- 2 Press the  softkey.
- 3 Select item by pressing arrow key and highlight selection.
- 4 Press  to change configuration.
- 5 Change the global configuration of the system as required.
- 6 Press
- 7 Press **Confirm** to store new settings

### Line Frequency

The line frequency indication is used to switch between 50 Hz and 60 Hz for the ECG filtering frequency.

---

**CAUTION** Ensure that the Line Frequency is set correctly for the country option ordered. The factory default is 60 Hz for all units.

---

### Settings Transfer

The patient-related settings of each parameter module can be stored in the EEPROM of the modules. During monitoring, changes in the active settings are recognized and saved. This allows the module to retain all settings, even if transported from one system to another. The Settings Transfer feature can be configured to “Yes” or “No”.

The parameter module stores its settings in its EEPROM until they are changed, either by modifying them in the parameter task window, or by resetting all parameter settings to user-configured default values while in Monitoring Mode. All parameter settings are reset to the user defaults when doing one of the following:

- Changing Operating Mode by pressing **Monitor Setup**, then  and then the  softkey.
- Changing the Configuration Set by pressing **Monitor Setup** and then the  softkey.

---

**NOTE** Both actions result in a “Restart”, in which the instrument is rebooted and the user default settings of the parameter module are stored in the EEPROM of the module.

---

The following types of modules support Settings Transfer:

- All modules with **T** marked on the front panel
- The Pressure, C.O., CO<sub>2</sub> and Temperature Modules (also without the **T** mark).

The ECG and ST applications have settings stored in the ECG and ECG/RESP modules respectively.

The instrument retains the labels of the multiple Module Setup, such as Temperature or Pressure. This Label Tracking feature is only active if Settings Transfer is set to Yes.

The parameter application software stores a label identifier. This allows the system to match the stored label with the parameters' set default label.

### **Setting the Altitude**

An adjustment for altitude must be entered before using the CO<sub>2</sub> and tcpO<sub>2</sub>/CO<sub>2</sub> Module. This is because the algorithm adjusts the measurement according to altitude. The altitude setting is made in the Global Switches task window.

### **Setting the Date and Time**

This facility allows you to set the system date and time. If the equipment is connected to the SDN Network, the date and time are set automatically by the Network.

Set the date and time as follows:

- 1 Press the **Monitor Setup** hardkey. The Monitor Setup selection window will appear.
- 2 Press the **Date/Time** softkey. The screen displays the Date and Time screen.
- 3 Change the day, month, year, hour and minute as required by pressing the corresponding softkeys.
- 4 Press **Confirm** after all the adjustments have been made. A message appears with the new date and time settings.
- 5 Press the **Monitor Setup** hardkey to return to the Monitor Setup menu.

### **Displaying the Status Log**

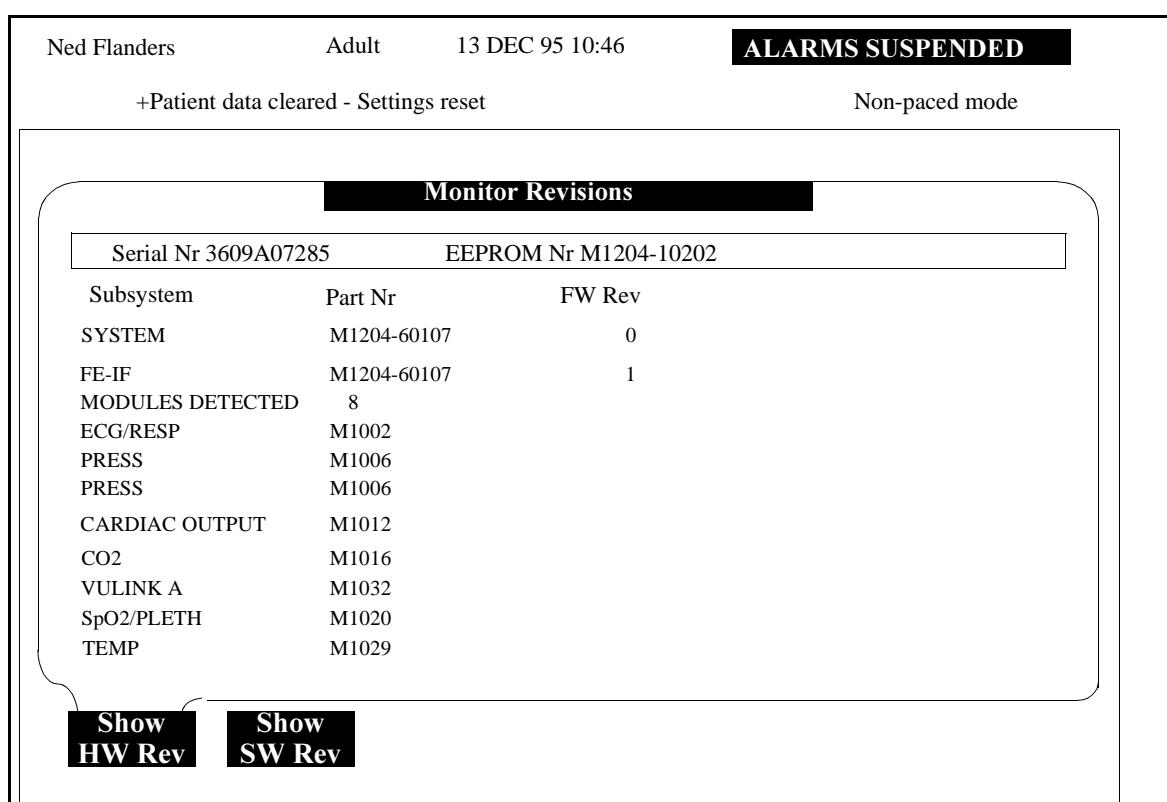
The Status Log contains error messages reported by the monitor either during the boot process or during operation. This information can be accessed in either Monitoring Mode or Service Mode.

## To Access Monitor Revisions Screen

- 1 Press **Monitor Setup**. The Monitor Setup should appear.
- 2 Press  softkey. The following screen will appear listing current parameter modules plugged into the instrument.

**NOTE**

Parameter Module Detection also functions in Monitor Mode



**Figure 4-1 Monitor Revisions Screen Depicting Current Parameter Modules**

The following information is contained in the header of the Monitor Revision Task Window:

- EEPROM Number: (for example: M1204-10202)
- Serial Number: (for example: 3609A07285)

### Displaying the Software or Hardware Revision

- 1 Press **Monitor Setup**.
- 2 Press .
- 3 Press the key corresponding to the required revision screen. ( or ).

### **Hardware Revision**

- Subsystem (for example: System)
- Part Number (hardware - for example: M1204-60107)
- Firmware Revision (for example: 0)

### **Software Revision**

The software revision screen lists the software revision of the monitor and the part number of the EEPROM.

### **Summary of the Power On Modes**

The type of Power On selected by the instrument depends on the down-time of the unit as follows:

**Table 4-5. Power On Modes According to Down Time**

System Down Time	Power On Mode
<1 minute	Hot Start
< 3 hours	Warm Start
> 3 hours	Cold Start
NA	Extended Test can only be selected in the Service Mode.
NA	X-Start (occurs when changing Operating Modes and configuration sets).

#### **Hot Start**

The instrument makes a hot start when it has been powered down for a period less than one minute.

The active user default values, including parameter module settings are recovered and retained on restart.

#### **Warm Start**

During a warm start the System behaves as during a cold start, but an abbreviated version of the self-test is carried out.

The system database for patient data management is checked and recovered. All active settings are lost.

### **Cold Start**

---

**CAUTION**

---

**During a cold start the System Board runs a detailed test of memory which erases the system database for patient data management. All active settings and patient data are lost.**

All user default values for configurable items, including parameter module settings, are restored and an extensive self-test is carried out.

When Settings Transfer is configured to ON, patient-related settings are recovered from the module front-end's non-volatile memory. The system database for patient data management is cleared. Leaving the Demo Mode causes a cold start. A cold start usually requires between 12 and 15 seconds before the Monitoring Mode is activated.

### **Extended Test**

---

**CAUTION**

---

**During the extended self-test the System Board runs a detailed memory test which erases the system database for patient data management. All patient data is lost as the memory test is equivalent to a cold start.**

This test is not performed during the standard boot process but is a software switch that can be selected in the Service Mode. (Press the "Monitor Setup" hardkey, and then the "Power-On Modes" softkey.)

When all components are tested successfully, the extended test takes between 2 and 2½ minutes to complete, and the upper limit is 255 seconds. An error message is directly displayed at the top of the screen when problems occur during the Extended test. After the test, inspect the Status Log for any device IDs and error codes generated.

### **X-Start**

During an X-start, the system reacts as after a cold start, the only difference being that the user default settings of the Monitor are downloaded to the EEPROM of the modules. An X-start occurs after changing operating mode or configuration set.

---

**NOTE**

---

Modules that are plugged in the System within 30 seconds after an "X-Start" is initiated, will receive the user default settings of the Agilent Monitor. Modules that are plugged in > 30 seconds after an X-Start is initiated will transfer the stored patient settings to the instrument.

*The power on modes are provided for service purposes only. They do not influence the monitoring power on behavior, which is not configurable.*

### Power On Mode Procedure

This facility enables the service engineer to perform a power on reset of the system. Use the Power On facility as follows:

- 1 Press **Monitor Setup**
- 2 Press **[ ]**
- 3 Type in the service password. The **[ ]** key is highlighted if the password is entered correctly.
- 4 Press **[ ]**

For a detailed description of the various power on modes that you can select, refer to Summary of the Power On Modes described in this chapter.

### Network Test

The test provides information about every SDN Device which is connected to the network. To start the Network Test, press the **Other Patients** hardkey, then press the softkey marked **[ ]**.

The Network Test information is presented on the screen in tabular format. The devices on each connected branch of the network are detailed in the table rows. Up to 15 rows of information are displayed at one time.

Use the **[ ] Scroll Page** and **[ ] Next Page** softkeys to scroll through the table, highlighting the items in the table. An example of the information displayed for one branch of the Network is provided below

**Table 4-6. Example of Network Test Information**

LBN	UNIT		REL	ERR	STATUS
03	MERL	0	X2	00	SDN, ON, NET, ST
00	PIC6M	6 R	X2	00	SDN, ON, NET
00	PIC6M	6 C	X2	00	SDN, ON, NET

#### Column: LBN

Lists the Branch Numbers to which each of the devices are connected. Central stations are always shown at Branch 0, even if they are connected to, for example, Branch 31.

**Column: UNIT**

Lists codes for the names of each device on each branch of the network. The codes, and the devices to which they refer, are as follows:

<b>CAREP</b>	78580A
<b>CLOV</b>	78534 Patient Monitor
<b>COMP1</b>	Computer
<b>COMP2</b>	Computer
<b>COMP3</b>	Computer
<b>COMP4</b>	Computer
<b>DIAG</b>	Diagnostic computer
<b>MERL</b>	Component Monitoring System or Agilent V24/V26 Series
<b>MINI</b>	783XX Series Patient Monitors
<b>PIC4C</b>	Patient Information Center (4 Bed Computer)
<b>PIC4M</b>	78504 Patient Information Center (4 Bed Monitoring) M2350/60 Agilent Component Central Monitor
<b>PIC6M</b>	78560 Patient Information Center (6 Bed Monitoring) M2350/60 Agilent Component Central Monitor
<b>PIC8C</b>	Patient Information Center (8 Bed Computer)
<b>PIC8M</b>	78508 Patient Information Center (8 Bed Monitoring) M2350/60 Agilent Component Central Monitor
<b>POGO</b>	78532 Patient Monitor
<b>REC_D</b>	Dedicated Recorder
<b>REC_S</b>	Shared Recorder (at Central Station)
<b>?????</b>	Unknown (new) device

**NOTE**

Each ++UNIT++ code is followed by a number. This number is a private subcode, used for internal purposes on the central station (Patient Information Center). It is not significant for service purposes.

Additional lines are displayed below the device line when a device is assigned to a central station (as in the previous example). This does not signify that the central station is physically connected to the same branch as the device.

When a device is assigned to a central station, the letter “C” or “R” is displayed between the UNIT and REL columns for the central station.

- A C indicates that the device is also assigned to an arrhythmia system.
- An R indicates that recordings can be made at the central station.

#### **Column: REL**

Displays the protocol release of each device on each branch.

#### **Column: ERR**

Lists hexadecimal error codes for each device on the network. If the code is “00”, no errors are present. Otherwise, interpret the error codes as follows:

- 1 Convert the two-digit hexadecimal error code to an eight-digit binary code.
- 2 Compare the resulting binary code with the error code chart below: Note the extreme left digit of the binary code is digit number “7”, the second from the left is number “6”, and so on. Each “1” in the binary code corresponds to an error.

**Table 4-7. Binary Code Error Chart**

Digits								Error Indicated
7	6	5	4	3	2	1	0	:
1	.	.	.	.	.	.	.	False SPS Event Flag
	1	.	.	.	.	.	.	Fatal Control Error Flag
		1	.	.	.	.	.	Recoverable Control Flag Error
			1	.	.	.	.	Physical Data Error Flag
				1	.	.	.	Logical Data Error Flag
					1	.	.	Poll Cycle Overflow Flag
						1	.	Command Response Fail Flag
							1	System Cycle Failure Flag

**Column: STATUS**

This column provides information about the SDN state of each device. An example status line would be:

*SDN, ON, NET, T*

Which can be interpreted as follows:

<b>SDN</b>	Device is connected to the SDN Network.
<b>NET</b>	Network is active.
<b>ON</b>	Device is on-line.
<b>T</b>	Test Mode is active.

If the device has only just been connected to the network, or has only just been powered up, the letters “ST” (for “START”) are also displayed.

## Performing the RS232 Loopback Test

An RS232 Transmit/Receive (loop back) test can be performed to check both the transmit and the receive capabilities of the RS232 port. The test is performed as follows:

**Step 1** Change to Service Mode.

**Step 2** Connect the RS232 loopback test connector to the RS232 port.<sup>1</sup>

**Step 3** Press **Monitor Setup**.

**Step 4** Press **RS232**.

**Step 5** Using the softkeys, configure the port to:

- Port #1: Comp On
- Baud Rate: 9600
- Tx/Rx #1 Order: High/Low

**Step 6** Press **Store Settings** and then press **Confirm**.

**Step 7** Power the instrument down.

**Step 8** Power the instrument up.

**Step 9** Press **Monitor Setup**.

**Step 10** Press **RS232**.

**Step 11** Press **Perform Test** to initiate the loopback test.

**NOTE**

The message "RS232 port receive and transmit test passed" appears with "Port #1 <-> Port #1" if the test is successful; if not, the message "RS232 port transmit and receive test failed" appears. If the test is unsuccessful, both the cable and the System Board should be examined and/or exchanged.

<sup>1</sup> A loopback test connector can be fabricated from either a 9-pin male connector (which can be directly connected to the RS232 port on the rear of the instrument) or from a 25-pin female connector (which can be connected to the RS 232 port through the RS232 cable supplied with the instrument).

**Table 4-8. RS232 Loopback Test Connector**

Pin Number 25 Pin	9 Pin	Signal Designation	Connection
2	3	TXD	•—R
3	2	RXD	•—R
4	7	RTS	•—R
5	8	CTS	•—R
6	6	DSR	•—R •
7	5	GND	
8	1	DCD	•—R
20	4	DTR	•—R
22	9	RI	OPEN

## NOTES:

1. R= 1.21K 1/8W resistor (Agilent Part No. 0757-0274). The resistor is used for current limit protection.
2. 25 Pin D-Sub Female Connector (Agilent PART NO. 1251-0064).
3. 25 Pin Connector Hood (Agilent Part No. 1251-1550)
4. Heat shrink tubing - apply as necessary to insulate connections (Agilent Part No. 0890-0706, per ft.)

## Display Tests

### Monochrome

- 1 Press **Monitor Setup** hardkey.
- 2 Press **Monitor Setup** hardkey again (or use arrow keys) to highlight upper row of choices.
- 3 Press **Display Tests** softkey.
- 4 Select display test to be executed followed by the **Confirm** hardkey.
- 5 Terminate an individual display test by pressing the **Confirm** hardkey again.
- 6 Select another display test or press **Monitor Setup** hardkey to return to Monitor Setup menu.

### Color

- 1 If you pressed any keys, return to the Main Screen by pressing the **Main Screen** hardkey.
- 2 Six tests can be run by pressing one of the first six softkeys at a time.

---

#### NOTE

---

Softkeys are not labelled.

- 3 Press **Monitor Setup** hardkey to return to the Monitor Setup menu.

## Description of the Boot Process

### Overview

The boot process takes place in the following four stages:

- 1 Hardware self test.
- 2 File transfer.
- 3 Software initialization - phase 1.
- 4 Software initialization - phase 2.

When all tests are successful and no hardware failures are detected, the boot process lasts between 12-15 seconds before ECG monitoring can begin. These tests are described in detail in the following subsections.

All start modes of the system (hot, warm, and cold starts) follow these four stages. Only the status of the system at the last power down, and the time elapsed before the system is powered on again, determine the start mode. In all start modes the ECG parameter screen is displayed between 12-15 seconds after the start-up is requested.

The actions performed in each start mode also differ in the extent to which the system components are tested. For example, a cold start runs more extensive memory tests than warm or hot starts.

An extended test can be activated in the Service Mode to run an extensive test of the Monitor. When selected, the extended test takes over the system after the hardware configuration has been determined in Stage 2 of the boot process.

### Stage 1: Hardware Self-Tests

During the first stage of the boot process all subsections in the System Board run their self-tests. The success of the tests is indicated by the red LEDs on the System Board.

At the start of the self test, the red LEDs are lit for 1 second, and then the SDN LED is turned off and the other two LEDs blink during normal operation.

Immediately following this stage, the system checks whether an external tool is connected, for example a cloning tool. If an external tool is detected, then it is given full control of the self-tested system hardware; none of the system software is activated.

### Stage 2: File Transfer and System Configuration

After 4 to 6 s from the boot request, information about the System Board configuration is read from the central EEPROM. This information indicates what software must be present.

**Stage 3: Software Initialization -- Phase 1**

In the first software initialization phase, each software module initializes its buffers. A check of the local buffer data is also made. If a hot start is made, the data should be correct in the local buffer on the CPU.

Any problems are reported to the Status Log. If software on one Application CPU reports a problem, the operating system will try to clear this buffered data by rebooting. This will usually solve all problems.

**Stage 4: Software Initialization -- Phase 2**

At this stage the different parts of the software check whether other optional hardware or software is available in that particular system.

After the second software initialization phase, the Monitoring Mode is activated.

## Fixing Recorder Problems

The V24/V26 Series uses the M1116A and M1116B Recorder Modules to make hard-copy recordings of the patient data which is displayed on the screen. The method for troubleshooting is the same for either recorder: identify the physical or functional problem, then find it in the accompanying table and follow the corrective action that is recommended.

**Table 4-9. Troubleshooting Recorder Problems**

Symptom	Possible Cause	Corrective Action
System thinks that door is open when it is not.	Module out of paper. Defective door switch.	Insert new paper roll. Replace door switch. Exchange module.
System thinks that the recorder is out of paper when it is not.	Paper-out sensor dirty or dusty.	Clean paper-out sensor.
Recorder not communicating with System.	Poor connection to the front-end rack.  Only one recorder module may be used with each monitor.  System not configured properly.  Too many modules connected.	Unplug the module. Plug it back in and try it again in a few seconds. (Watch for the LED to flash.)  Remove one of the recorder modules.  Check the configuration of the connected monitor.  Check and remove the extra modules.
Recorder won't run.	Recorder interface not working correctly.	Unplug the module. Plug it back in and try it again in a few seconds. (Watch for the LED to flash.)
Poor print quality.	Printhead dirty.  Printhead failure.	Clean the Printhead as described in Chapter 2 of this manual.  Exchange the module.
Paper not feeding properly.	Paper roll off center.  Dirty roller.	Center paper roll on roller guides.  Clean roller.
Module does not lock into rack.	Locking plates defective.	Remove and exchange the locking plates.

## Fixing Printing Problems

External printers can be connected to the V24/V26 Series through the RS232 Connector. This module shows you how to troubleshoot problems based on symptoms given by a printer. Use this module if your printer is causing a malfunction of the V24/V26 Series or if you are referred to this module from another procedure.

**Table 4-10. Troubleshooting the External Printer**

Symptom	Possible Cause	Corrective Action
“No Printer Available” or “Printer Malfunction” status message.	Printer not connected to monitor or central station.  Printer out of paper.  Printer off.  Printer configured incorrectly.  Wrong printer set-up in Configuration Mode.  Printer malfunction.  RS232 Interface defective.	Check printer interface cable.  Check paper.  Check printer power cord and switch.  Check printer settings.  Check printer configuration settings in Configuration Mode (under Trends/Calc or Patient Data).  Consult service manual supplied with printer.  Exchange System Board

## Local “Jet” Printer Configurations

The following table gives a summary of the local printer configurations. While color DeskJet printers are compatible with the V24/V26 Series, color printouts are not supported. Note that the DeskJet 540 and DeskJet 600 configure internally.

**Table 4-11. Local Jet Printer Configurations**

	BANK A	BANK B
	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8
ThinkJet	D D D D D D D D	U D D D U - - -
QuietJet	D U D D D D D D	D U D D D U DD
DeskJet 500	D D U D D * D D	D U D D U D DU
DeskJet 550C	D D D U D * D D	D U D D D U DD

\* DeskJet Printer Switch settings for Bank A Switch 6 are Up for A4 (metric paper) and Down for A (US format).

## **HP LaserJet/LaserJet+ Printers**

The switch positions required to print locally on the HP LaserJet/LaserJet + printers are:

- S1: OFF ON ON OFF OFF OFF ON ON
- S2: All OFF
- S3: All OFF
- S4: All OFF.

## **HP LaserJet II/III/IV Series Printers**

The configuration for printing locally to the HP LaserJet II/III/IV printers is set using the keys on the control panel of the printer:

SYM SET	=ROMAN--8*
AUTO CONT	=OFF*
I/O	=SERIAL*
BAUD RATE	=19200*
ROBUST XON	=ON*
DTR POLARITY	=HI*.

## **HP 2673A Printer**

The configuration for printing locally to an HP 2673A printer is as follows:

BAUD RATE	:19200
PARITY	:NONE
HANDSHAKES	:XON/XOFF HARDWARE
DATA BITS	:8
STOP BITS	:1
STRIP NULL/DEL	:OFF.

---

### **NOTE**

Local printers that only have a parallel port can be connected to the Model V24/V26 serial port using a serial-to-parallel converter (Agilent part number 5962-4340).

# Chapter 5 Troubleshooting Plug-in Modules

This chapter tells you how to troubleshoot problems that come from faults within the plug-in modules or the associated circuitry within the rest of the instrument. The modules use visual indications, error messages, and INOP messages to indicate a fault. All references to the Agilent Model V24/V26 also refer to the Agilent Model V24C/V26C and Model V24CT/V26CTunless specifically stated.

See “Procedure Overview” on page 5-2 for a more detailed overview.

## Objectives

This chapter shows you how to:

- Recognize a properly operating Plug-in Module.
- Identify symptoms of improper operation of the Plug-in Modules.
- Use any symptoms or indications to identify a fault as being in the Plug-in Modules.
- Further isolate faults down to field-replaceable assemblies.

## Concepts

This chapter uses visual indications, Inops, error messages and other operational symptoms to help you diagnose problems with the Agilent Plug-in Modules. Symptoms have been grouped based on the measurement performed by the Plug-in Module.

Each troubleshooting section contains procedures for isolating faults based on the symptoms, any supporting theory as to why you are being told to do a certain procedure, and any additional rationale that will help you to isolate faults.

- **Inops** – Inops are messages displayed on the screen when the V24/V26 cannot measure or process signals properly. This could be due to patient-related or equipment-related problems. This section deals only with those Inops which are equipment related.
- **Task Window** – The task window is an operating level of the V24/V26 which allows you to make changes or adjustments to the parameters or screen displays, or to perform procedures. Each parameter has a series of task windows which can be accessed by pressing the setup key on the parameter module. This section uses the task windows for each parameter to check for error messages.

---

## Procedure Overview

**Table 5-1 Troubleshooting and Self-Test Procedures**

Topic	Page
Troubleshooting tcpO2/tcpCO2 Problems	<a href="#">5-3</a>
Troubleshooting ECG and ECG/RESP Problems	<a href="#">5-8</a>
Troubleshooting Pressure Problems	<a href="#">5-10</a>
Troubleshooting NBP Problems	<a href="#">5-12</a>
Troubleshooting Cardiac Output Problems	<a href="#">5-14</a>
Troubleshooting SpO2/Pleth Problems	<a href="#">5-17</a>
Troubleshooting Temperature Module Problems	<a href="#">5-19</a>
Troubleshooting CO2 Problems	<a href="#">5-21</a>
Troubleshooting Blood Analysis Problems	<a href="#">5-24</a>
Troubleshooting BIS Problems	<a href="#">5-29</a>
Troubleshooting VueLink Module Problems	<a href="#">5-37</a>
Self-Test Procedure Overview	<a href="#">5-40</a>
Performing the ECG or ECG/RESP Module Self-Test	<a href="#">5-42</a>
Performing the M1006A/B Pressure Module Self-Test	<a href="#">5-42</a>
Performing the NBP Module Self-Test	<a href="#">5-43</a>
Performing the SpO2/Pleth Module Self-Test	<a href="#">5-43</a>
Performing the Cardiac Output Module Self-Test	<a href="#">5-43</a>
Performing the tcpO2/tcpCO2 Module Self-Test	<a href="#">5-44</a>
Performing the CO2 Module Self-Test	<a href="#">5-44</a>
Performing the Temperature Module Self-Test	<a href="#">5-45</a>
Performing the Blood Analysis Module Self-Test	<a href="#">5-45</a>
Performing the Recorder Module Self-Test	<a href="#">5-45</a>
Performing the VueLink Module Self-Test	<a href="#">5-46</a>

## Troubleshooting tcpO<sub>2</sub>/tcpCO<sub>2</sub> Problems

This section describes how to troubleshoot and correct faults associated with the tcpO<sub>2</sub>/tcpCO<sub>2</sub> module. The procedures for recognizing, isolating, and correcting faults using this module are as follows:

- Identifying a problem based on visual indications or repeated INOPS.
- Checking the tcpO<sub>2</sub>/tcpCO<sub>2</sub> task window for specific error messages and performing the corrective actions suggested in the table given with this module.
- Calibrating the module as required.

### To Troubleshoot the Module

- If neither numerics nor a -?- are displayed for the tcpO<sub>2</sub>/tcpCO<sub>2</sub> module, perform the following actions:

**Step 1** Make sure there is a transducer connected to the module. If no transducer is connected, connect one.

**Step 2** Make sure the tcpO<sub>2</sub>/tcpCO<sub>2</sub> parameter is turned on. Turn it on, if it is not.

**Step 3** Make sure the tcpO<sub>2</sub>/tcpCO<sub>2</sub> numeric is turned on. Turn it on, if it is not.

**Step 4** Make sure you don't have more than one tcpO<sub>2</sub>/tcpCO<sub>2</sub> module plugged into the module racks you are using. If more than one tcpO<sub>2</sub>/tcpCO<sub>2</sub> module is plugged in, the supernumerary modules are ignored and should be removed.

**Step 5** Check the connection on the module and the rack interface.

1. Unplug and re-plug the tcpO<sub>2</sub>/tcpCO<sub>2</sub> module and check if the green LED on the tcpO<sub>2</sub>/tcpCO<sub>2</sub> module lights up after re-plugging. If it does not, proceed with the following:

2. Put the tcpO<sub>2</sub>/tcpCO<sub>2</sub> module into another slot and check the LED once again. If it lights up now, the connector for the previous slot is faulty and the rack needs to be replaced. If it does not, proceed with the following:

3. *Note: this procedure applies only for setups, in which the tcpO<sub>2</sub>/tcpCO<sub>2</sub> module is located in a Satellite Rack. If this does not apply for your situation, proceed with 4.*

Replace the cable from the Satellite Rack to the function box. Again unplug and re-plug the tcpO<sub>2</sub>/tcpCO<sub>2</sub> module and check if the LED lights up. If it does not, proceed with the following:

4. Plug any other (not faulty) module into the same slot and check if the LED lights up. If the LED of the alternative module lights up, the tcpO<sub>2</sub>/tcpCO<sub>2</sub> module is defect and has to be replaced. If it does not, either the rack or the rack interface card is defect. Proceed with the following:

- 5.** Replace the rack and plug in the tcpO<sub>2</sub>/tcpCO<sub>2</sub> module into the new rack. If the LED on the module does not light up, replace the rack interface card in the function box.
- If a **-?- instead of a numeric** and one or more INOP messages are displayed for the tcpO<sub>2</sub>/tcpCO<sub>2</sub> module, perform the following actions:

*Please note that for proceeding to the next steps a transducer must be connected to the module.*

- Step 1** Perform a module self-test (See “Performing the tcpO<sub>2</sub>/tcpCO<sub>2</sub> Module Self-Test” on page 5-44). If the tcpO<sub>2</sub> test numeric reads exactly 60 mmHg (8.0 kPa) and the tcpCO<sub>2</sub> test numeric reads exactly 40 mmHg (5.3 kPa), proceed to the next step, if not, replace the module.
- Step 2** Enter the tcpO<sub>2</sub>/tcpCO<sub>2</sub> Task Window by pressing the setup key on the tcpO<sub>2</sub>/tcpCO<sub>2</sub> module. The Task Window displays messages dealing with the tcpO<sub>2</sub>/tcpCO<sub>2</sub> module failures. The following table describes the messages and corrective actions to take.

**Table 5-2 Task Window messages for the tcpO<sub>2</sub>/tcpCO<sub>2</sub> Module**

Message	Possible Cause	Corrective Action
TC Equip Malf, with prompt: module malfunction.	Module is faulty.	Unplug then re-plug the Module. If the error prompt reappears within 10 seconds, exchange the Module.
	Transducer has been inserted and removed into/from calibration chamber too frequently.	Unplug, then re-plug the module.
	Microswitch in Calibration chamber is intermittent.	Unplug and re-plug the module. If the error prompt reappears any time after 10 seconds, replace the Calibration chamber.
TC Equip Malf, with prompt: equipment malfunction. The transducer is plugged in.	Polarization voltage or transducer supply voltage is out of range.	Disconnect the transducer. If the prompt changes to module malfunction, exchange the module. Otherwise replace the transducer.
	Heating malfunction in the transducer.	Swap transducers to verify prompt message. If necessary, replace transducer.
	Heating control in module is defective.	Swap transducers to verify prompt message. If necessary, exchange module.
No numeric values, and no -?- in standard display when transducer is plugged in, but not inserted in the Calibration chamber.	Microswitch in Calibration chamber is faulty.	Replace the Calibration chamber.

**Table 5-2 Task Window messages for the tcpO<sub>2</sub>/tcpCO<sub>2</sub> Module**

Message	Possible Cause	Corrective Action
Prompt: insert transducer in chamber appears when the transducer is in the chamber and the calibration is started.	Microswitch in Calibration chamber is faulty.	Replace the Calibration chamber.
Calibration has passed, but readings fluctuate more than 2.0 mmHg (0.3kPa)/30 seconds.	Membrane/electrolyte worn out.	Re-membrane the transducer and restart the calibration. If the values still fluctuate more than 2.0 mmHg (0.3kPa)/30 seconds, replace the transducer.

**Step 3** Refer to the following table. Correct the possible cause identified by the INOP message and verify that the INOP disappears.

**Table 5-3 INOP Messages for the tcpO<sub>2</sub>/tcpCO<sub>2</sub> Module**

INOP Message	Possible Cause	Corrective Action
tc UN-PLUGGED	Parameter is ON and unplugged from rack.	Perform Step 5 on page 5-3.
tc EQUIP MALF	Malfunction in the transducer or the module.	Refer to the related Task Window messages in Table 5-2 on page 5-4.
tc NO TRANSDUC	No transducer is connected to the module.	Connect transducer to module.
tc CHANGE SITE	The site timer in the module has expired.	Change application site and restart timer.
tc CAL FAILED	Calibration failed due to out of range or unstable signal during calibration.	For more information on the calibration of the module, refer to tcpO <sub>2</sub> /tcpCO <sub>2</sub> Module section of the <i>User's Reference Manual</i>
tc CAL REQUIRD	Calibration is required before applying the transducer to the patient.	Run a Calibration as described in tcpO <sub>2</sub> /tcpCO <sub>2</sub> Module section of the <i>User's Reference Manual</i> . Note: if the message is still displayed after calibration, run the calibration again. If you get the same message again, replace the module.
tc CAL RUNNING	A calibration is running.	Wait until calibration is finished.
tc STABILIZING	The transducer has not yet reached the selected temperature and/or the skin is not ready to be measured.	Wait until measurement site has warmed up and values become stable.
tc CHECK TIME	Site timer due to expire in 15 minutes or less.	Change application site and restart timer.

- If tcpO<sub>2</sub>/tcpCO<sub>2</sub> **readings are questionable**, perform the following actions:

Perform a tcpO<sub>2</sub> zero check and tcpCO<sub>2</sub> gain check for the transducer. These checks tell you whether the tcpO<sub>2</sub>/tcpCO<sub>2</sub> transducer is working correctly.

## Test Equipment

The following list gives you the test equipment recommended to perform the specification test on the tcpO<sub>2</sub>/tcpCO<sub>2</sub> plug-in:

- 1 Calibration Unit (Agilent 15210B or Radiometer TCC3)
- 1 Calibration gas bottle of Cal 1 gas (20.9% O<sub>2</sub>, 5% CO<sub>2</sub>) (see Chapter 11 “Replacement Parts”)
- 1 Calibration gas bottle of Cal 2 gas (0% O<sub>2</sub>, 10% CO<sub>2</sub>) (see Chapter 11 “Replacement Parts”)
- 1 Accessory Kit (15209-60010)
- 1 tcpO<sub>2</sub>/CO<sub>2</sub> transducer (Agilent M1918A or Radiometer transducer)
- 1 Calibration Tubing (M2205A)

## Procedure

**Step 1** Ensure correct function of the Calibration Unit.

**Step 2** Make sure that you are not in Service mode.

**Step 3** Set the transducer temperature to 43.0° C.

**Step 4** Using a calibration unit (Agilent M1918A or Radiometer calibration unit TCC3) and Cal 1 gas, calibrate the module as described in the tcpO<sub>2</sub>/tcpCO<sub>2</sub> Module section of the *User’s Reference Manual*.

**Step 5** Check and note down the displayed values for tcpO<sub>2</sub> and tcpCO<sub>2</sub>. The values should not fluctuate more than 2 mmHg (0.3kPa) in 30 seconds.

**Step 6** If the readings fluctuate more than 2 mmHg (0.3kPa), re-membrane the transducer ensuring that the old electrolyte is thoroughly removed and check whether you need to activate the transducer. The tcpO<sub>2</sub>/tcpCO<sub>2</sub> Module section of the *User’s Reference Manual* tells you how to do this.

**Step 7** Repeat steps 4 and 5. If the test fails again, the transducer has unacceptable drift and has to be replaced. Repeat steps 4 and 5 with new transducer.

**Step 8** Replace the Cal 1 gas cylinder on the calibration unit with the Cal 2 gas cylinder. Turn on the gas supply of your calibration unit.

**Step 9** Check the values displayed on the screen. The displayed tcpO<sub>2</sub> must be < 6 mmHg (0.8kPa) within 10 minutes. The displayed tcpCO<sub>2</sub> value must be within the range listed in the table within 10 minutes. If the tcpO<sub>2</sub> is not < 6 mmHg (0.8kPa), and/or tcpCO<sub>2</sub> values are not within the acceptance range listed in the tables given, the transducer does not measure correctly and needs to be replaced.

**Table 5-4 Calibration Values**

tcpCO <sub>2</sub> at CAL1 gas		Min. tcpCO <sub>2</sub> at CAL2 gas		Max. tcpCO <sub>2</sub> at CAL2 gas	
39 mmHg	5.2 kPa	74 mmHg	9.9 kPa	88 mmHg	11.7 kPa
38 mmHg	5.1 kPa	72 mmHg	9.7 kPa	86 mmHg	11.5 kPa
37 mmHg	5.0 kPa	70 mmHg	9.5 kPa	84 mmHg	11.3 kPa
36 mmHg	4.9 kPa	68 mmHg	9.3 kPa	81 mmHg	11.1 kPa
35 mmHg	4.8 kPa	66 mmHg	9.1 kPa	79 mmHg	10.8 kPa
34 mmHg	4.7 kPa	64 mmHg	8.9 kPa	77 mmHg	10.6 kPa
33 mmHg	4.6 kPa	62 mmHg	8.7 kPa	75 mmHg	10.4 kPa
32 mmHg	4.5 kPa	60 mmHg	8.5 kPa	72 mmHg	10.2 kPa
31 mmHg	4.4 kPa	59 mmHg	8.3 kPa	70 mmHg	9.9 kPa
30 mmHg	4.3 kPa	57 mmHg	8.1 kPa	68 mmHg	9.7 kPa
29 mmHg	4.2 kPa	55 mmHg	7.9 kPa	66 mmHg	9.5 kPa
28 mmHg	4.1 kPa	53 mmHg	7.7 kPa	63 mmHg	9.3 kPa
27 mmHg	4.0 kPa	51 mmHg	7.5 kPa	61 mmHg	9.1 kPa
26 mmHg	3.9 kPa	49 mmHg	7.4 kPa	59 mmHg	8.8 kPa
25 mmHg	3.8 kPa	47 mmHg	7.2 kPa	57 mmHg	8.6 kPa
24 mmHg	3.7 kPa	45 mmHg	7.0 kPa	55 mmHg	8.4 kPa
23 mmHg	3.6 kPa	43 mmHg	6.8 kPa	52 mmHg	8.2 kPa
22 mmHg	3.5 kPa	41 mmHg	6.6 kPa	50 mmHg	7.9 kPa
21 mmHg	3.4 kPa	39 mmHg	6.4 kPa	48 mmHg	7.7 kPa
20 mmHg	3.3 kPa	37 mmHg	6.2 kPa	46 mmHg	7.5 kPa
19 mmHg	3.2 kPa	35 mmHg	6.0 kPa	43 mmHg	7.3 kPa

## Troubleshooting ECG and ECG/RESP Problems

This section describes how to troubleshoot and correct faults associated with the ECG/RESP module. The procedures for recognizing, isolating, and correcting faults using this module are as follows:

- Identifying a problem based on visual indications or repeated INOPS.

### To Troubleshoot the Module

- If neither numerics nor a -?- are displayed for the ECG/RESP module, perform the following actions:

**Step 1** Make sure there is a trunk cable with lead set connected to the module. If not, connect one.

**Step 2** Make sure the ECG and RESP parameters are turned on. If they are not, turn them on.

**Step 3** Make sure the ECG (HR) and RESP numerics are turned on. If they are not, turn them on.

**Step 4** Make sure you don't have more than one ECG/RESP module plugged into the module racks you are using. If more than one ECG/RESP module is plugged in, the supernumerary modules are ignored and should be removed.

**Step 5** Check the connection on the module and the rack interface.

1. Unplug and re-plug the ECG/RESP module and check if the green LED on the ECG/RESP module lights up after re-plugging. If it does not, proceed with the following:

2. Put the ECG/RESP module into another slot and check the LED once again. If it lights up now, the connector for the previous slot is faulty and the rack needs to be replaced. If it does not, proceed with the following:

3. *Note: this procedure applies only for setups, in which the ECG/RESP module is located in a Satellite Rack. If this does not apply for your situation, proceed with 4.*

Replace the cable from the Satellite Rack to the function box. Again unplug and re-plug the ECG/RESP module and check if the LED lights up. If it does not, proceed with the following:

4. Plug any other (not faulty) module into the same slot and check if the LED lights up. If the LED of the alternative module lights up, the ECG/RESP module is defect and has to be replaced. If it does not, either the rack or the rack interface card is defect. Proceed with the following:

5. Replace the rack and plug in the ECG/RESP module into the new rack. If the LED on the module does not light up, replace the rack interface card in the function box.

- If a **-?- instead of a numeric** and one or more INOP messages are displayed for the ECG/RESP module, perform the following actions:

*Please note that for proceeding to the next steps a trunk cable with lead set must be connected to the module.*

**Step 1** Perform a module self-test (See “Performing the ECG or ECG/RESP Module Self-Test” on page 5-42). If the ECG/RESP test numerics read exactly the listed values, proceed to the next step, if not, replace the module.

**Step 2** Refer to the following table. Correct the possible cause identified by the INOP message and verify that the INOP disappears. If the problem still exists, replace the module.

**Table 5-5 INOP Messages for ECG and ECG/Resp**

INOP Message	Possible Cause	Corrective Action
LEADS OFF	Not all required leads are attached or electrodes have been displaced. With activated EASI™ option the wrong lead set is used. Lead set or ECG Module may be defective.	Make sure all electrodes are correctly attached. With activated EASI™ option make sure you are using the correct (5 electrode) lead set. If INOP still is displayed, change lead set. If INOP persists, replace module.
LEADS OFF XX	Single electrode from lead xx detached.	Attach the missing electrode. If INOP still is displayed, see Corrective Action for “LEADS OFF”
LEADS OFF (EL.X)	Single electrode from lead E,S or I is detached (EASI™ lead set).	Attach the missing electrode. If INOP still is displayed, see Corrective Action for “LEADS OFF”
ECG/RESP UNPLUGGED	ECG/RESP module is unplugged from the rack.	Perform Step 5 on page 5-8.
ECG EQUIP MALF	Malfunction in ECG hardware.	Replace module.
ECG/RESP UNPLUGGED	ECG/RESP module is unplugged from the rack.	Perform Step 5 on page 5-8.
RESP LEAD OFF	RESP lead is off, electrode detached, or patient cable unplugged.	Make sure all electrodes are correctly attached. If INOP still is displayed, change lead set. If INOP persists, replace module.
RESP EQUIP MALF	Malfunction in RESP hardware.	Replace module.

## Troubleshooting Pressure Problems

This section describes how to troubleshoot and correct faults associated with the M1006A and M1006B Pressure plug-in modules. The procedures for recognizing, isolating, and correcting faults with this module are as follows:

- Identifying a problem based on visual indications or repeated INOPS.

### To Troubleshoot the Module

- If neither numerics nor a -?- are displayed for the PRESSURE module, perform the following actions:

- Step 1** Make sure there is a transducer connected to the module. If no transducer is connected, connect one.
- Step 2** Make sure the PRESSURE parameter is turned on. Turn it on, if it is not.
- Step 3** Make sure the PRESSURE numeric is turned on. Turn it on, if it is not.
- Step 4** If you want to measure CPP, make sure that one PRESSURE parameter is labeled ICP and both pressures display valid numerics.
- Step 5** Make sure you don't have too many PRESSURE module plugged into the module racks you are using. If too many PRESSURE modules are plugged in, you get two status messages: "Too many modules of the same type connected" and "Currently ignored module in rack position x.x". The last message enables you to identify the supernumerary module.  
These modules are ignored and should be removed.
- Step 6** Check the connection on the module and the rack interface.
  1. Unplug and re-plug the PRESSURE module and check if the green LED on the PRESSURE module lights up after re-plugging. If it does not, proceed with the following:
  2. Put the PRESSURE module into another slot and check the LED once again. If it lights up now, the connector for the previous slot is faulty and the rack needs to be replaced. If it does not, proceed with the following:
  3. *Note: this procedure applies only for setups, in which the PRESSURE module is located in a Satellite Rack. If this does not apply for your situation, proceed with 4.*  
Replace the cable from the Satellite Rack to the function box. Again unplug and re-plug the PRESSURE module and check if the LED lights up. If it does not, proceed with the following:
  4. Plug any other (not faulty) module into the same slot and check if the LED lights up. If the LED of the alternative module lights up, the PRESSURE module is defect and has to be replaced. If it does not, either the rack or the rack interface card is defect. Proceed with the following:

5. Replace the rack and plug in the PRESSURE module into the new rack. If the LED on the module does not light up, replace the rack interface card in the function box.
- If a **-?- instead of a numeric** and one or more INOP messages are displayed for the PRESSURE module, perform the following actions:

*Please note that for proceeding to the next steps a transducer must be connected to the module.*

**Step 1** Perform a module self-test (See “Performing the M1006A/B Pressure Module Self-Test” on page 5-42). If the PRESSURE test numerics read exactly the listed values, proceed to the next step, if not, replace the module.

**Step 2** Refer to the following table. Correct the possible cause identified by the INOP message and verify that the INOP disappears. If the problem still exists, replace the module.

**Table 5-6 INOP Messages for Pressure**

INOP Message	Possible Cause	Corrective Action
<Px> UNPLUGGED	Pressure module is unplugged from the rack.	Perform Step 6 on page 5-10.
<Px> NO TRANSDUCER	No transducer connected to the module.	Connect transducer to module.
<Px> EQUIP MALF	Malfunction in the pressure hardware.	Replace module.
<Px> ZERO + CHECK CAL	Occurs when new transducer attached to module, or when the power is off for longer than one minute and settings transfer is off.	Zero the PRESSURE module.
<Px> OVERRANGE	Measured pressure >361 mmHg, <-41 mmHg.	Replace transducer. If the INOP persists, replace module.
CPP CHECK SOURCES	Occurs for one minute if either the arterial or the intracranial pressure sources are switched off, or the front end modules are removed.	Connect module properly to rack and make sure that the PRESSURE parameter is turned on. Make sure you get valid numerics for ICP and the other pressure. Make sure that the preselected pressure label in the CPP source window is the same as for the second pressure.
CPP CHECK UNITS	Occurs if two pressure sources have different units.	Use the same unit for all PRESSURE modules.

*Agilent uses invasive pressure as reference for NBP. Diastolic measurements can be up to 8 mmHg lower than pressure measured by auscultatory (Korotkoff) method.*

## Troubleshooting NBP Problems

To ensure accurate NIBP measurements, the NBP plug-in module can be calibrated. Agilent recommends that the module is calibrated once every 12 months.

This section describes how to troubleshoot and correct faults associated with the NBP module. The procedures for recognizing, isolating, and correcting faults with this module are as follows:

- Identifying a problem based on visual indications or repeated INOPS.
- Checking the NBP task window for specific error messages and performing the corrective actions suggested in the table given with this module.
- Calibrating the module as required.

### To Troubleshoot the Module

- If neither numerics nor a -?- are displayed for the NBP module, perform the following actions:

- Step 1** Make sure the NBP parameter is turned on. Turn it on, if it is not.
- Step 2** Make sure the NBP numeric is turned on. Turn it on, if it is not.
- Step 3** Make sure you don't have more than one NBP module plugged into the module racks you are using. If more than one NBP module is plugged in, the supernumerary modules are ignored and should be removed.
- Step 4** Check the connection on the module and the rack interface.
  1. Unplug and re-plug the NBP module and check if the green LED on the NBP module lights up after re-plugging. If it does not, proceed with the following:
  2. Put the NBP module into another slot and check the LED once again. If it lights up now, the connector for the previous slot is faulty and the rack needs to be replaced. If it does not, proceed with the following:
  3. *Note: this procedure applies only for setups, in which the NBP module is located in a Satellite Rack. If this does not apply for your situation, proceed with 4.*  
Replace the cable from the Satellite Rack to the function box. Again unplug and re-plug the NBP module and check if the LED lights up. If it does not, proceed with the following:

4. Plug any other (not faulty) module into the same slot and check if the LED lights up. If the LED of the alternative module lights up, the NBP module is defect and has to be replaced. If it does not, either the rack or the rack interface card is defect. Proceed with the following:
  5. Replace the rack and plug in the NBP module into the new rack. If the LED on the module does not light up, replace the rack interface card in the function box.
- If a **-?- instead of a numeric** and one or more INOP messages are displayed for the NBP module, perform the following actions:

**Step 1** Refer to the following table. Correct the possible cause identified by the INOP message and verify that the INOP disappears. If the problem still exists, replace the module.

**Table 5-7 INOP Messages for the NBP Module**

INOP Message	Possible Cause	Corrective Action
NBP UNPLUGGED	NBP is unplugged from rack.	Perform Step 4 on page 5-12.
NBP EQUIP MALF	Hardware problem in module or tubing.	Exchange the tubing and restart measurement. If the INOP reoccurs and the message in the NBP task window reads "Pressure values of transducers different", attempt a calibration (See "Performance Test NBP Module" on page 5-6). If this fails, replace the module.
NBP INTERRUPTED	Strong patient movement or Inflation/deflation timeout – pump problem.	Make sure the patient does not move strongly and restart measurement.  Check whether cuff is connected. Check tubing and cuff for leakages and restart measurement.
NBP CUFF OVER-PRESS	Strong patient movement or defect in pneumatic control.	Restart measurement making sure that patient does not move strongly. If INOP reoccurs, replace module.
NBP INCORRECT CUFF	Neonatal cuff used for adult patient size setting.	Make sure the patient size configuration is set to PEDI/NEO and restart measurement.
CUF NOT DEFLATED	Hardware problem in module or tubing.	Exchange the tubing and restart measurement. If the INOP reoccurs, replace module.

## Troubleshooting Cardiac Output Problems

This section describes how to troubleshoot and correct faults associated with the Cardiac Output plug-in module. The procedures for recognizing, isolating, and correcting faults with this module are as follows:

- Identifying a problem based on visual indications or repeated INOPS.

### To Troubleshoot the Module

- If neither numerics nor a -?- are displayed for the C.O. module, perform the following actions:

- Step 1** Make sure there is a C.O. Interface Cable and a catheter connected to the module. If not, connect them.
- Step 2** Make sure the C.O. parameter is turned on. Turn it on, if it is not.
- Step 3** Make sure the C.O. numeric is turned on. Turn it on, if it is not.
- Step 4** Make sure you don't have more than one C.O. module plugged into the module racks you are using. If more than one C.O. module is plugged in, the supernumerary modules are ignored and should be removed.
- Step 5** Check the connection on the module and the rack interface.
  1. Unplug and re-plug the C.O. module and check if the green LED on the C.O. module lights up after re-plugging. If it does not, proceed with the following:
  2. Put the C.O. module into another slot and check the LED once again. If it lights up now, the connector for the previous slot is faulty and the rack needs to be replaced. If it does not, proceed with the following:
  3. *Note: this procedure applies only for setups, in which the CO module is located in a Satellite Rack. If this does not apply for your situation, proceed with 4.*  
Replace the cable from the Satellite Rack to the function box. Again unplug and re-plug the CO module and check if the LED lights up. If it does not, proceed with the following:
  4. Plug any other (not faulty) module into the same slot and check if the LED lights up. If the LED of the alternative module lights up, the C.O. module is defect and has to be replaced. If it does not, either the rack or the rack interface card is defect. Proceed with the following:
  5. Replace the rack and plug in the C.O. module into the new rack. If the LED on the module does not light up, replace the rack interface card in the function box.

- If a **-?- instead of a numeric** and one or more INOP messages are displayed for the C.O. module, perform the following actions:

*Please note that for proceeding to the next steps a C.O. Interface Cable plus catheter and Injectate Temperature Probe or the Service Tool (M1012-61601) must be connected to the module.*

- Step 1** Refer to the following table. Correct the possible cause identified by the INOP message and verify that the INOP disappears. If the problem still exists, proceed to the next step.

**Table 5-8 INOP Messages for the C.O. Module**

INOP Message	Possible Cause	Corrective Action
C.O. UNPLUGGED	C.O. module is unplugged from the rack.	Perform Step 5 on page 5-14.
Tblood NO TRANSDUC	No C.O. Interface Cable attached to the module. Catheter not connected to C.O. Interface Cable or cable broken.	Make sure that all cables are properly connected and the connectors are free from dirt. Connect Service Tool M1012-61601 to C.O. Interface Cable <sup>1</sup> . The Tblood numeric must read exactly 37.0 +/- 0.1°C, otherwise the module or C.O. Interface Cable is defect and has to be replaced. If you get the correct reading from the Service Tool and the INOP still appears, replace the catheter. If the INOP still appears, replace the C.O. Interface Cable. If the INOP still appears, replace the module.
C.O. EQUIP MALF	Malfunction in the C.O. hardware.	Perform Step 5 on page 5-14. If INOP is still displayed, replace module.

1. For correct use of the Service Tool, see “Performance Test Cardiac Output” on page 2-9

- Step 2** Enter the Measure C.O. Task Window by pressing the START key on the C.O. module. The Measure C.O. Task Window displays messages dealing with C.O.

module failures. The following table describes the messages and corrective actions to take.

**Table 5-9 Task Window messages for the C.O. Module**

Task Window Message	Possible Cause	Corrective Action
no Tinj transducer connected	Cable of Injectate Temperature Probe is not connected or broken. Faulty module.	<p>Make sure that cable of the Injectate Temperature Probe is properly connected to the C.O. Interface Cable and the connector is free from dirt.</p> <p>Connect Service Tool M1012-61601 to C.O. Interface Cable<sup>1</sup>.</p> <p>You must get the following results, otherwise the module or C.O. Interface Cable are defect and have to be replaced: Tinj numeric reads exactly 0.0°C No prompt message “Tinj transducer connected” appears in the Measure C.O. Task Window.</p> <p>If you get the correct results from the Service Tool and the Task Window message still appears, replace the Injectate Temperature Probe.</p>
Unknown catheter	Faulty C.O. Interface Cable, module or catheter.	<p>Make sure that catheter and C.O. Interface Cable are properly connected and the connector is free from dirt.</p> <p>Connect Service Tool M1012-61601 to C.O. module<sup>a</sup>.</p> <p>If Task Window message now has disappeared, replace catheter.</p> <p>If Task Window message still appears, replace C.O. Interface Cable.</p> <p>If Task Window message still appears, replace module.</p>

1. For correct use of the Service Tool, see “Performance Test Cardiac Output” on page 2-9

- If a **small -?- in addition to a numeric** and one or more INOP messages are displayed for the C.O. module, the values are questionable. Correct the possible cause identified by the INOP message and verify that the INOP disappears.

**Table 5-10 INOP Messages with questionable values for the C.O. Module**

INOP Message	Possible Cause	Corrective Action
SVR MISSING CVP	No valid CVP available at the moment. CVP is automatically set to 0 mmHg for the continuous SVR calculation	<p>If you need an accurate continuous SVR measurement, perform a CVP measurement and make sure that the pressure which is used for the CVP measurement is labeled “CVP”.</p> <p>Make sure you get valid numerics for CVP.</p> <p>For more information refer to the Pressure Module section in the <i>User’s Reference Manual</i>.</p>

## Troubleshooting SpO<sub>2</sub>/Pleth Problems

This section describes how to troubleshoot and correct faults associated with the SpO<sub>2</sub>/Pleth plug-in module. The procedures for recognizing, isolating, and correcting faults with this module are as follows:

- Identifying a problem based on visual indications or repeated INOPS.

### To Troubleshoot the Module

- If **neither numerics nor a -?- are displayed** for the SpO<sub>2</sub>/Pleth module, perform the following actions:

**Step 1** Make sure there is a transducer connected to the module. If no transducer is connected, connect one.

**Step 2** Make sure the SpO<sub>2</sub>/Pleth parameter is turned on. Turn it on, if it is not.

**Step 3** Make sure the SpO<sub>2</sub>/Pleth numeric is turned on. Turn it on, if it is not.

**Step 4** Make sure you don't have too many SpO<sub>2</sub>/Pleth module plugged into the module racks you are using. If too many SpO<sub>2</sub>/Pleth modules are plugged in, you get two status messages: "Too many modules of the same type connected" and "Currently ignored module in rack position x.x". The last message enables you to identify the supernumerary module.

These modules are ignored and should be removed.

**Step 5** Check the connection on the module and the rack interface.

1. Unplug and re-plug the SpO<sub>2</sub>/Pleth module and check if the green LED on the SpO<sub>2</sub>/Pleth module lights up after re-plugging. If it does not, proceed with the following:

2. Put the SpO<sub>2</sub>/Pleth module into another slot and check the LED once again. If it lights up now, the connector for the previous slot is faulty and the rack needs to be replaced. If it does not, proceed with the following:

3. *Note: this procedure applies only for setups, in which the SpO<sub>2</sub>/Pleth module is located in a Satellite Rack. If this does not apply for your situation, proceed with 4.*

Replace the cable from the Satellite Rack to the function box. Again unplug and re-plug the SpO<sub>2</sub>/Pleth module and check if the LED lights up. If it does not, proceed with the following:

4. Plug any other (not faulty) module into the same slot and check if the LED lights up. If the LED of the alternative module lights up, the SpO<sub>2</sub>/Pleth module is defect and has to be replaced. If it does not, either the rack or the rack interface card is defect. Proceed with the following:

5. Replace the rack and plug in the SpO<sub>2</sub>/Pleth module into the new rack. If the LED on the module does not light up, replace the rack interface card in the function box.

- If a **-?- instead of a numeric** and one or more INOP messages are displayed for the SpO<sub>2</sub>/Pleth module, perform the following actions:

*Please note that for proceeding to the next steps a transducer must be connected to the module.*

- Step 1** Perform a Self-Test (See “Performing the SpO<sub>2</sub>/Pleth Module Self-Test” on page 5-43). If the SpO<sub>2</sub>/Pleth test numerics read exactly the listed values, proceed to the next step, if not, replace the module.
- Step 2** Refer to the following table. Correct the possible cause identified by the INOP message and verify that the INOP disappears. If the problem still exists, replace the module.

**Table 5-11 INOP Messages for the SpO<sub>2</sub>/Pleth Module**

INOP Message	Possible Cause	Corrective Action
SpO <sub>2</sub> /PLETH NO TRANSDUCER	No transducer is connected to the module	Connect transducer to module.
SpO <sub>2</sub> /PLETH EQUIP MALF	Malfunction in the transducer or module.	Replace transducer. If INOP persists, replace module
SpO <sub>2</sub> /PLETH UNPLUGGED	SpO <sub>2</sub> /PLETH module is unplugged from the rack.	Perform Step 5 on page 5-17
SpO <sub>2</sub> ERRATIC	Erratic SpO <sub>2</sub> measurements, often due to a faulty transducer, or invalid SpO <sub>2</sub> measurements; often due to the transducer being incorrectly positioned.	Reposition transducer. If the INOP persists, replace transducer.
SpO <sub>2</sub> /PLETH NOISY SIGNAL	Patient movement or electrical interference are causing irregular pulse patterns.	Make sure that patient does not move strongly. If INOP persists, move cable away from power cords.
SpO <sub>2</sub> /PLETH INTERF	Level of ambient light and/or cable induced electrical interference is so high, that the SpO <sub>2</sub> transducer cannot measure pulse rate.	Cover transducer against ambient light and move cable away from power cords.
SpO <sub>2</sub> /PLETH NON-PULSATILE	Pulse is too weak or not detectable.	Move transducer to another application site.
PLETH REDUCE SIZE	Transducer displaced or strong vasodilation after automatic wave fixing.	Press Optimize Size softkey in PLETH Task Window to restore the PLETH wave.
SpO <sub>2</sub> TRANSD MALF or PLETH TRANSD MALF	SpO <sub>2</sub> transducer is defective due to inadequate diode output.	Replace the transducer.

## Troubleshooting Temperature Module Problems

This section describes how to troubleshoot and correct faults associated with the Temperature plug-in module. The procedures for recognizing, isolating, and correcting faults using this module are as follows:

- Identifying a problem based on visual indications or repeated INOPS.

### To Troubleshoot the Module

- If **neither numerics nor a -?- are displayed** for the TEMP module, perform the following actions:

**Step 1** Make sure there is a TEMP probe connected to the module. If not, connect one.

**Step 2** Make sure the TEMP parameter is turned on. Turn it on, if it is not.

**Step 3** Make sure the TEMP numeric is turned on. Turn it on, if it is not.

**Step 4** Make sure you don't have too many TEMP module plugged into the module racks you are using. If too many TEMP modules are plugged in, you get two status messages: "Too many modules of the same type connected" and "Currently ignored module in rack position x.x". The last message enables you to identify the supernumerary module.

These modules are ignored and should be removed.

**Step 5** Check the connection on the module and the rack interface.

1. Unplug and re-plug the TEMP module and check if the green LED on the TEMP module lights up after re-plugging. If it does not, proceed with the following:

2. Put the TEMP module into another slot and check the LED once again. If it lights up now, the connector for the previous slot is faulty and the rack needs to be replaced. If it does not, proceed with the following:

3. *Note: this procedure applies only for setups, in which the TEMP module is located in a Satellite Rack. If this does not apply for your situation, proceed with 4.*

Replace the cable from the Satellite Rack to the function box. Again unplug and re-plug the TEMP module and check if the LED lights up. If it does not, proceed with the following:

4. Plug any other (not faulty) module into the same slot and check if the LED lights up. If the LED of the alternative module lights up, the TEMP module is defect and has to be replaced. If it does not, either the rack or the rack interface card is defect. Proceed with the following:

5. Replace the rack and plug in the TEMP module into the new rack. If the LED on the module does not light up, replace the rack interface card in the function box.

- If a **-?- instead of a numeric** and a INOP message is displayed for the TEMP module, perform the following actions:

*Please note that for proceeding to the next steps a transducer must be connected to the module.*

- Step 1** Perform a Self-Test (See “Performing the Temperature Module Self-Test” on page 5-45). If the TEMP test numeric reads exactly the listed value, proceed to the next step, if not, replace the module.
- Step 2** Refer to the following table. Correct the possible cause identified by the INOP message and verify that the INOP disappears. If the problem still exists, replace the module.

**Table 5-12 INOP Messages for the Temp Module**

INOP Message	Possible Cause	Corrective Action
<Tx> UNPLUGGED	TEMP module is unplugged from the rack.	Perform Step 5 on page 5-19.
<Tx> NO TRANSDUC	Temperature probe disconnected from the module.	Connect Temperature probe to module.
<Tx> OVERRANGE	Temperature out of range <-1°C or >45°C.	Replace Temperature probe. If problem still persists, replace module.
<Tx> EQUIP MALF	Malfunction in the TEMP module hardware	Replace module.

## Troubleshooting CO<sub>2</sub> Problems

This section describes how to troubleshoot and correct faults associated with the CO<sub>2</sub> plug-in module. The procedures for recognizing, isolating, and correcting faults with this module are as follows:

- Identifying a problem based on visual indications or repeated INOPS.

### To Troubleshoot the Module

- If **neither numerics nor a -?- are displayed** for the CO<sub>2</sub> module, perform the following actions:

**Step 1** Make sure there is a transducer connected to the module. If no transducer is connected, connect one.

**Step 2** Make sure the CO<sub>2</sub> parameter is turned on. Turn it on, if it is not.

**Step 3** Make sure the CO<sub>2</sub> numeric is turned on. Turn it on, if it is not.

**Step 4** Make sure you don't have more than one CO<sub>2</sub> module plugged into the module racks you are using. If more than one CO<sub>2</sub> module is plugged in, the supernumerary modules are ignored and should be removed.

**Step 5** Check the connection on the module and the rack interface.

1. Unplug and re-plug the CO<sub>2</sub> module and check if the green LED on the CO<sub>2</sub> module lights up after re-plugging. If it does not, proceed with the following:

2. Put the CO<sub>2</sub> module into another slot and check the LED once again. If it lights up now, the connector for the previous slot is faulty and the rack needs to be replaced. If it does not, proceed with the following:

3. *Note: this procedure applies only for setups, in which the CO<sub>2</sub> module is located in a Satellite Rack. If this does not apply for your situation, proceed with 4.*

Replace the cable from the Satellite Rack to the function box. Again unplug and re-plug the CO<sub>2</sub> module and check if the LED lights up. If it does not, proceed with the following:

4. Plug any other (not faulty) module into the same slot and check if the LED lights up. If the LED of the alternative module lights up, the CO<sub>2</sub> module is defect and has to be replaced. If it does not, either the rack or the rack interface card is defect. Proceed with the following:

5. Replace the rack and plug in the CO<sub>2</sub> module into the new rack. If the LED on the module does not light up, replace the rack interface card in the function box.

- If a **-?- instead of a numeric** and one or more INOP messages are displayed for the CO<sub>2</sub> module, perform the following actions:

*Please note that for proceeding to the next steps a transducer must be connected to the module.*

- Step 1** Perform a Self-Test (See “Performing the CO<sub>2</sub> Module Self-Test” on page 5-44). If the CO<sub>2</sub> test numerics read exactly the listed values, proceed to the next step, if not, replace the module.
- Step 2** Refer to the following table. Correct the possible cause identified by the INOP message and verify that the INOP disappears. If the problem still exists, replace the module.

**Table 5-13 INOP Message for CO<sub>2</sub> Module**

INOP Message	Possible Cause	Corrective Action
CO <sub>2</sub> UNPLUGGED	CO <sub>2</sub> module is unplugged from the rack.	Perform Step 5 on page 5-21.
CO <sub>2</sub> EQUIPM MALF	Malfunction in the transducer or module.	Replace transducer. If INOP persists replace module.
CO <sub>2</sub> NO TRANS-DUCER	No Transducer is connected to the module.	Connect transducer to module. Run a calibration as described in CO <sub>2</sub> Module section of the <i>User’s Reference Manual</i> . (If the transducer is replaced, the new transducer must be re-calibrated.)
CO <sub>2</sub> FAILED CAL	Calibration aborted due to power failure, unstable signal during calibration, or transducer being placed on the wrong cal cell.	Run a calibration as described in CO <sub>2</sub> Module section of the <i>User’s Reference Manual</i> . Make sure that calibration cell is changed when prompted. If INOP persists replace module.
CO <sub>2</sub> SENSOR WARM UP	The transducer has not reached operating temperature.	Wait until transducer has warmed up.
CO <sub>2</sub> CAL RUNNING	The CO <sub>2</sub> calibration is running.	Wait until calibration is finished.
CO <sub>2</sub> CAL MODE	Cal mode is set but the calibration has not been initiated.	Perform accuracy check or start a calibration as described in CO <sub>2</sub> Module section of the <i>User’s Reference Manual</i> .
CO <sub>2</sub> CHECK CAL	CO <sub>2</sub> value <-2mmHg, >150mmHg.	Perform accuracy check for low and high calstick cell as described in CO <sub>2</sub> Module section of the <i>User’s Reference Manual</i> .
CO <sub>2</sub> REDUCE SIZE	ETCO <sub>2</sub> >60mmHg in 40mmHg wave scale.	Select the 60 mmHg scale. This enables the full wave to be displayed.
CO <sub>2</sub> LOW FLOW	Sidestream flow between 50-80 ml for up to 10 minutes. CO <sub>2</sub> values may not be accurate.	Replace tubing.

**Table 5-13 INOP Message for CO<sub>2</sub> Module**

<b>INOP Message</b>	<b>Possible Cause</b>	<b>Corrective Action</b>
CO <sub>2</sub> OCCLUSION	Sidestream flow between 50-80 ml for more than 10 minutes or Tubing locked in pump system, tubing or filter to patient.	Replace tubing.
CO <sub>2</sub> SIDESTRM MALF	Sidestream malfunction in the transducer or module.	Replace module.
CO <sub>2</sub> SIDESTRM OFF	Pump automatically has turned off after 60 min of C02 < 3 mmHg or apnea.	Restart Sidestream in CO <sub>2</sub> setup.

## Troubleshooting Blood Analysis Problems

This section describes how to troubleshoot and correct faults associated with the Blood Analysis plug-in module. The procedures for recognizing, isolating, and correcting faults with this module are as follows:

- Identifying a problem based on repeated INOPS.
- Checking the Blood Analysis task window for specific error messages and performing the corrective actions suggested in the table given with this module.

### To Troubleshoot the Module

- If you are **unable to access the Blood Analysis module Task Window**, perform the following actions:

- Step 1** Make sure the Blood Analysis parameter is turned on. Turn it on, if it is not.
- Step 2** Make sure you don't have more than one Blood Analysis module plugged into the module racks you are using. If more than one Blood Analysis module is plugged in, the supernumerary modules are ignored and should be removed.
- Step 3** Check the connection on the module and the rack interface.
  1. Unplug and re-plug the Blood Analysis module and check if the 2 green LEDs on the Blood Analysis module light up after re-plugging. If they do not, proceed with the following:
  2. Put the Blood Analysis module into another slot and check the LEDs once again. If they light up now, the connector for the previous slot is faulty and the rack needs to be replaced. If they do not, proceed with the following:
  3. *Note: this procedure applies only for setups, in which the Blood Analysis module is located in a Satellite Rack. If this does not apply for your situation, proceed with 4.*  
Replace the cable from the Satellite Rack to the function box. Again unplug and re-plug the Blood Analysis module and check if the LEDs light up. If they do not, proceed with the following:
  4. Plug any other (not faulty) module into the same slot and check if the LEDs light up. If the LEDs of the alternative module light up, the Blood Analysis module is defect and has to be replaced. If it does not, either the rack or the rack interface card is defect. Proceed with the following:
  5. Replace the rack and plug in the Blood Analysis module into the new rack. If the LEDs on the module do not light up, replace the rack interface card in the function box.

- If **INOP messages** are displayed for the Blood Analysis module, perform the following actions. More detailed information relating to the cause of some of the INOPs can be found in the Blood Analysis Task Window (see Table 5-15 on page 5-26). Correct the possible cause identified by the INOP message and verify that the INOP disappears.

**Table 5-14 INOP Messages for Blood Analysis Module**

INOP Message	Possible Cause	Corrective Action
BLOODANL UNPLUGGED	Blood Analysis module has been unplugged from the rack.	Perform Step 3 on page 5-24.
BLOODANL EQU. MALF	Permanent malfunction in the module.	Refer to the related Task Window messages in Table 5-15 on page 5-26.
BLOODANL CONFIG	A configuration problem has been detected.	Refer to the related Task Window messages in Table 5-15 on page 5-26.
BLOODANL ROOM TEMP?	Module environment is too warm or too cold - operating range 16 to 30°C (64 to 86°F).	Refer to the related Task Window messages in Table 5-15 on page 5-26.

- If a **measurement is unsuccessful** or parameters are missing, perform the following actions:

**Step 1** *Note: This step only applies for customers, who preselected the <Result Selection> ON in Configuration Mode.*

Make sure that all parameter results you intended to display are switched on in the Results Selection Task Window.

If you have already confirmed the measurement, perform a new measurement to check, if the error still exists. If you haven't confirmed the measurement yet, the change will be visible immediately.

**Step 2** The Task Window displays messages dealing with Blood Analysis module failures. The following table describes the messages and corrective actions to take.

If errors occur repeatedly, make a note of the error codes as these can be used for diagnostic purposes at the factory and must be documented when a module is exchanged.

**Table 5-15 Task Window messages for the Blood Analysis Module**

Message in Task Window	INOP or prompt message	Error Code	Possible Cause	Corrective Action
Temperature out of range	BLOOD-ANL ROOM TEMP	2	The room temperature is too cold or warm - operating range is 16 to 30°C (64 to 86°F).  The filter is blocked or the ventilator fan in the module malfunctions.	Ensure that ambient temperature is within the operating limits and leave time for the module to acclimatize after transport or storage.  Inspect the filter and clean it if necessary. If the message still appears, call your service representative.
New Software Installed, Use Simulator		3	The software or CLEW was recently updated.	Run the electronic simulator.
Analysis Interrupted, Use Other Cartridge		4, 8	Module has been pulled out of the rack during a measurement and then replaced.	Wait for the locked LED to go off then remove the cartridge and start the measurement again with a new cartridge.
Invalid Date, Check clock	BLOOD-ANL CON-FIG	11	Implausible date in V24/V26.	Check date settings in the V24/V26 and make sure they are correct.
Invalid or Expired CLEW, See Manual	BLOOD-ANL CON-FIG	12, 13	Invalid date code in V24/V26.  CLEW version maybe expired.  CLEW update has not been successfully finished.	Check date settings in the V24/V26 and make sure your date settings are correct.  Refer to the application note of the current CLEW version.  Reinstall the current CLEW version.
Invalid Customization Data	BLOOD-ANL CON-FIG	14	Customization update unsuccessful	Reinstall the current Customization version.
Invalid Software Detected	BLOOD-ANL CON-FIG	53	Wrong software type installed.	Update System with correct type of software.

**Table 5-15 Task Window messages for the Blood Analysis Module**

Message in Task Window	INOP or prompt message	Error Code	Possible Cause	Corrective Action
Incompatible Language	BLOOD-ANL CON-FIG	297	V24/V26 language and module language are not compatible.	Call your service representative.
Module Error, Use Electronic Simulator	Blood Analysis failed	48, 50-52, 58-62, 70	A cartridge or electronic simulator was inserted at an angle or the simulator is malfunctioning.	If the error occurs when using a cartridge, run the electronic simulator. If the error occurs when running the simulator, use another simulator. If the error recurs, the module or simulator may need repair - call your service representative.
Module Error, See Manual	BLOOD-ANL EQU. MALF	1, 23, 63, 65-68, 72-74, 76-78, 82, 85, 86, 89, 90, 91-94, 256-296, 298-299	May have various malfunction causes located in the module.	Use an electronic simulator twice then use a cartridge with sample or control solution. If an error condition occurs, call your service representative.
Cartridge Not Inserted Properly	Blood Analysis failed	47	Cartridge or simulator is probably not pushed in completely.  Cartridge was removed after starting a measurement.	Reinsert the cartridge or electronic simulator.  Start measurement with a new cartridge.  If error recurs, call your service representative.
Cartridge Pre-burst, Use Other Cartridge	Blood Analysis failed	21	The module detected fluid on the Sensors before it should have.	Cartridge was probably either pressed in the centre bursting the calibration pack or was stored in conditions too warm or too cold. Try another cartridge.

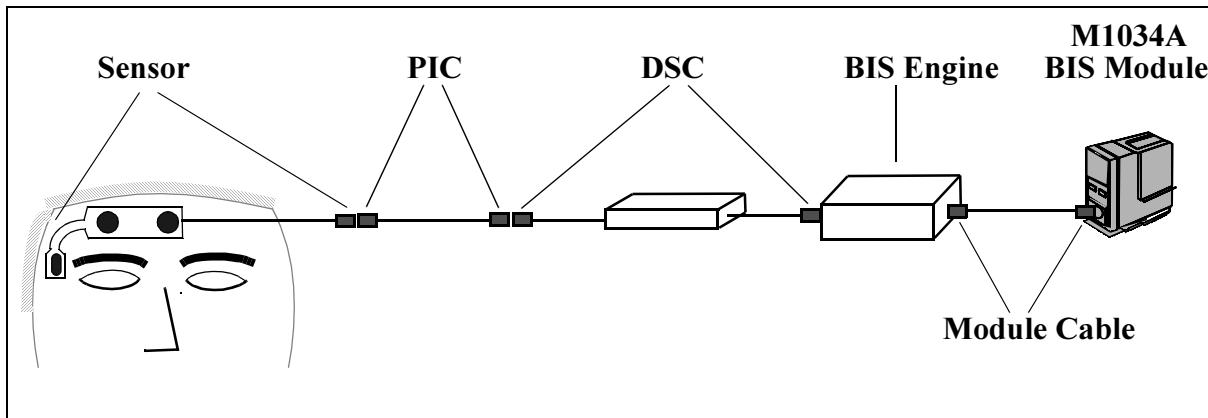
**Table 5-15 Task Window messages for the Blood Analysis Module**

<b>Message in Task Window</b>	<b>INOP or prompt message</b>	<b>Error Code</b>	<b>Possible Cause</b>	<b>Corrective Action</b>
Unable to Position Sample	Blood Analysis failed	31, 34	No movement of sample detected, possibly due to a clot in sample, not closing the sample well cover or an aberrant cartridge.	Perform a new measurement making sure that you fill the cartridge properly.
Sample Positioned Short of Fill Mark	Blood Analysis failed	35, 36	The cartridge was underfilled, the sample must reach the fill mark.	Perform a new measurement making sure that you fill the cartridge properly.
Sample Positioned Beyond Fill Mark	Blood Analysis failed	30, 37	Cartridge was over-filled. The sample was past the fill mark.	Perform a new measurement making sure that you fill the cartridge properly.
Insufficient sample	Blood Analysis failed	38, 39	Either not enough sample in the sample well or there are bubbles in the sample.	Perform a new measurement making sure that you fill the cartridge properly and without bubbles.
Cartridge Error, Use Other Cartridge	Blood Analysis failed	20, 22, 24-29, 32, 33, 40-43, 45, 46, 79, 80, 81, 87	Can be caused by sample related problems, cartridge or module. Single or sporadic errors are most likely a sample-related problem (an interference), an aberrant cartridge or a user-induced situation such as touching contacts or pressing on center of cartridge.	Try another cartridge. If error recurs repeatedly, call your service representative.
Cartridge Type Not Recognized	Blood Analysis failed	69	Either the cartridge type is not compatible with the software revision, or the module is at fault.	If this is a new type of cartridge being used, arrange a software upgrade. If not, call your service representative.

## Troubleshooting BIS Problems

This section describes how to troubleshoot and correct faults associated with the BIS components. The procedures for recognizing, isolating, and correcting faults using these components are as follows:

- Identifying a problem based on visual indications or repeated INOPS.



**BIS Components Overview**

### To Troubleshoot the Module

- If neither numerics nor a -?- are displayed for the BIS module, perform the following actions:
- Step 1** Make sure that BIS Engine, DSC and BIS Sensor are connected to the module. If not, connect the missing devices.
  - Step 2** Make sure the BIS parameter is turned on. Turn it on, if it is not.
  - Step 3** Make sure the BIS numeric is turned on. Turn it on, if it is not.
  - Step 4** Make sure you don't have more than one BIS module plugged into the module racks you are using. If more than one BIS module is plugged in, the supernumerary modules are ignored and should be removed.
  - Step 5** Check the connection on the module and the rack interface.
    1. Unplug and re-plug the BIS module and check if the green LED on the BIS module lights up after re-plugging. If it does not, proceed with the following:
    2. Put the BIS module into another slot and check the LED once again. If it lights up now, the connector for the previous slot is faulty and the rack needs to be replaced. If it does not, proceed with the following:
    3. Note: this procedure applies only for setups, in which the BIS module is located in a Satellite Rack. If this does not apply for your situation, proceed with 4.

Replace the cable from the Satellite Rack to the function box. Again unplug and re-plug the BIS module and check if the LED lights up. If it does not, proceed with the following:

4. Plug any other (not faulty) module into the same slot and check if the LED lights up. If the LED of the alternative module lights up, the BIS module is defect and has to be replaced. If it does not, either the rack or the rack interface card is defect. Proceed with the following:

5. Replace the rack and plug in the BIS module into the new rack. If the LED on the module does not light up, replace the rack interface card in the function box.

- If a **-?- instead of a numeric** and one or more INOP messages or a **small -?- in addition to a numeric** are displayed for the BIS module, perform the following actions:

*Please note that for proceeding to the next steps a BIS Engine, DSC and BIS Sensor must be connected to the module.*

**Step 1** Refer to the following table. Correct the possible cause identified by the INOP message and verify that the INOP disappears. The order of the possible causes reflects their likelihood. Always start with the first to troubleshoot.

**Table 5-16 INOP Messages for the BIS Module**

INOP Message	Possible Cause	Corrective Action
BIS UN-PLUGGED	BIS module is unplugged from the rack.	Perform Step 5 on page -29
BIS MODULE MALFUNC	Malfunction in the BIS module hardware.  Overcurrent situation.	Enter BIS Task Window <sup>1</sup> . Look for the message “BIS Engine or DSC overcurrent”. If it is <i>not</i> displayed, replace BIS module.  If it <i>is</i> displayed, perform the following procedure: Disconnect the BIS Engine from module and replug BIS module. If INOP persists, replace module. If INOP disappears, reconnect BIS Engine <i>without DSC</i> to module. If INOP persists, replace BIS Engine. If INOP disappears, reconnect DSC to BIS Engine. If INOP persists, replace DSC. If INOP disappears, replace Module Cable.
BIS ENGINE DISCONN	BIS Engine not connected.  Module Cable defective.	Make sure that the Module Cable is properly connected.  If INOP persists replace Module Cable.

**Table 5-16 INOP Messages for the BIS Module**

INOP Message	Possible Cause	Corrective Action
BIS ENGINE INCOMPAT	BIS Engine Software is not supported.	A software upgrade may be required. Enter BIS Task Window <sup>1</sup> and write down the Revision numbers displayed for “Module FW Rev” and “BIS Eng SW Rev”. Check the latest version of the compatibility matrix provided either on page 5-36 or in the latest Service Note, whichever is more recent.
BIS ENGINE MALFUNC	Malfunction in the BIS Engine hardware.	Replace BIS Engine.
BIS DSC DISCONN	DSC is not properly connected  Either DSC cable or BIS Engine may be faulty.	Make sure that the DSC is properly connected to the adjacent devices.  If INOP persists replace DSC <sup>2</sup> . If INOP persists replace BIS Engine.
BIS DSC MALFUNC	Electrocautery used during self-test.  Malfunction in the BIS DSC hardware.  PIC may be faulty.	Make sure not to use electrocautery during the self-test procedure.  Perform a PIC/DSC Test as described under Self-Test Procedures for BIS components on page 5-34. If it fails replace DSC2.  If INOP persists replace PIC.
BIS DSC INCOMPAT	DSC is not supported by the BIS Engine or new DSC connected to an old BIS Engine.	A software upgrade may be required. Enter BIS Task Window <sup>1</sup> and note the Revision number displayed for “BIS Eng SW Rev” and the DSC ID. Check the latest version of the compatibility matrix provided either on page 5-36 or in the latest Service Note, whichever is more recent.
BIS SENSOR MALFUNC	Malfunction in the Sensor hardware, most often caused by liquids permeating into the connectors.  PIC or short cable of the DSC may be faulty.	Replace Sensor. Enter BIS Task Window <sup>1</sup> and press “START CHECK” to initiate a Cyclic Impedance Check. Make sure all leads have passed the test. Make sure that the PIC connector (between PIC and Sensor) is dry. If you are not sure that the connector is dry, replace PIC until it has dried.  If INOP persists perform the PIC/DSC Test as described under Self-Test Procedures for BIS components on page 5-34. If it fails replace PIC. If INOP persists replace DSC2.

**Table 5-16 INOP Messages for the BIS Module**

INOP Message	Possible Cause	Corrective Action
BIS SENSOR DISCONN	Sensor not properly connected to PIC and/or PIC not properly connected to DSC. Sensor or PIC or short cable of DSC faulty.	Make sure that the BIS Sensor is properly connected to the PIC and the PIC is properly connected to the DSC.  If INOP persists, perform a PIC/DSC Test as described under Self-Test Procedures for BIS components on page 5-34. If it fails replace Sensor. If INOP persists replace PIC. If INOP persists replace DSC <sup>2</sup> .
BIS SENSOR INCOMP	Unsupported Sensor connected or Sensor type unknown.  PIC or short cable of the DSC may be faulty.	Make sure to use only Agilent supported Sensors.  Perform the PIC/DSC Test as described under Self-Test Procedures for BIS components on page 5-34. If it fails replace PIC. If INOP persists replace DSC <sup>2</sup> .
BIS SENSOR USAGE	Sensor expired due to too often usage.  PIC or short cable of the DSC may be faulty.	Replace Sensor. Enter BIS Task Window. Make sure all leads have passed the Cyclic Impedance Check, which has been automatically performed.  Perform the PIC/DSC Test as described under Self-Test Procedures for BIS components on page 5-34. If it fails replace PIC. If INOP persists replace DSC <sup>2</sup> .
BIS SQI < 15%	The signal quality is below 15% and the BIS value cannot be calculated. This may occur as a result of artifact such as those generated from motion or the presence of electrocautery devices.	Make sure the Sensor is properly attached to the patient: Enter BIS Task Window <sup>1</sup> and press “START CHECK” to initiate a Cyclic Impedance Check. Make sure all leads have passed the test.  Make sure the patient is completely relaxed (even small motions of the facial muscles affect the signal quality).
BIS IMPEDANCE CHCK	The Cyclic Impedance check is running.	Wait until Cyclic Impedance Check has finished or press “STOP CHECK” in the Cyclic Check Task Window.
BIS LEAD OFF	One or more leads (electrodes) have no skin contact.	Press the electrode pads firmly. If INOP persists, replace Sensor providing proper skin preparation.

**Table 5-16 INOP Messages for the BIS Module**

INOP Message	Possible Cause	Corrective Action
BIS HIGH IMPEDANCE	Impedance of one or more electrode(s) is above the valid range, most often caused by bad skin preparation.  PIC or short cable of the DSC faulty.	Press the electrode pads firmly. If INOP persists, replace Sensor providing proper skin preparation.  If INOP persists perform a PIC/DSC Test as described under Self-Test Procedures for BIS components on page 5-34. If it fails replace PIC. If INOP persists replace DSC <sup>2</sup> .
BIS ISOELECTRIC EEG	No discernible EEG activity is detected for longer than 1 minute.	Check the patient. Check the leads for proper connection.
BIS SQI < 50%	The signal quality is below 50%. This may occur as a result of artifact such as those generated from motion or the presence of electrocautery devices.	Make sure the Sensor is properly attached to the patient: Enter BIS Task Window <sup>1</sup> and press “START CHECK” to initiate a Cyclic Impedance Check. Make sure all leads have passed the test.  Make sure the patient is completely relaxed (even small motions of the facial muscles affect the signal quality).

1. To enter BIS Task Window press (in Monitoring Mode) MODULE SETUP followed by BIS
2. Before ordering a new DSC, try another one of the same type, if available.

## Self-Test Procedures for BIS components

### PIC/DSC Test

**TEST** In Monitoring mode connect the **Sensor Simulator** (for maximum usage please refer to the documentation delivered with the Sensor Simulator) to the Patient Interface Cable (for part number please refer to Table 6-16 on page 6-25).

Enter the BIS Task Window by pressing **Module Setup**, followed by **BIS**.

Start Impedance Check by pressing **Start Check**. This brings up the BIS Cyclic Check Task Window. Check the displayed results.

**RESULTS** PIC and DSC are functioning correctly and the test is passed, if the following results are displayed:

Electrode	Expected Value
1	4-6 kΩ
2	8-12 kΩ
3	1-3 kΩ

If the test fails, firstly replace PIC with a known good one. Perform test again. If it fails again, DSC is faulty and has to be replaced.

---

**NOTE** If the DSC/PIC Test alternately passes and fails, this indicates a broken DSC cable. In this case you have to replace the DSC.

---

### DSC Self-Test

If the correct functioning of the DSC is in doubt, perform the DSC self-test.

---

**NOTE** The DSC and long cable only are covered by this test, not the short cable (which can be tested by the PIC/DSC Test described above).  
This test is not available directly after connecting the DSC. Wait at least 10 seconds until the DSC has stabilized.  
Do not run this test while electrocautery equipment is in use. This will cause a failure.

---

**TEST** Enter Service Mode

Enter the BIS Self-Test Task Window by pressing **Module Setup**, followed by **BIS**.

Start Test by pressing **Test DSC**.

**RESULTS** DSC is functioning correctly and the test is passed with the following results displayed:

Module: **Test passed**  
 BIS Engine: **Test passed**  
 DSC: **Test passed**

The small table located right of the “DSC Test passed / failed” entry lists more detailed results of the DSC Self-Test.

### Additional information available in the Service Mode Task Window

The Service Mode Task Window provides additional information, which is explained in the following section. To enter the window, change to Service Mode and press **Module Setup** followed by **BIS**. Please wait at least 10 seconds until all results are valid.

If the connected sensor has a malfunction (indicated by “Test failed” in the Sensor section of the Service Mode Task Window), in some cases it is necessary that you disconnect the sensor and unplug the module before continuing.

BIS Self Test				
Module	FW Rev:	1.07	S/N:	3305C03478
	<b>Test passed</b>			
BIS Engine	SW Rev:	2.05	S/N:	C00432
	FW Rev:	2.41	HW Rev:	1.50
	<b>Test passed</b>			
DSC	ID:	9	Channel	1      2
	FW Rev:	3.0	Gain	
	<b>Test passed</b>			
	<b>High Pass blocked</b>			
	<b>High Pass normal</b>			
	<b>Noise</b>			
PIC	ID:	7		
Sensor	Type:	1	Code:	0x003C4015
	S/N:	3441		
	<b>Test passed</b>			
Diag Data:				
<input type="button" value="Test"/> <input type="button" value="DSC"/>				

Note: the screen shown above is only an example and does not show real data.

For an explanation of the individual entries see next page.

Module		DSC	
FW Rev	Installed Firmware Revision of the BIS module.	ID	Type of DSC used. Supported types: 9 (DSC-3).
S/N <sup>1</sup>	Serial Number of the BIS module used.	FW Rev	Installed Firmware Revision of the DSC.
Test passed / failed	Result of the automatic BIS Self-Test <sup>2</sup> .	Test passed / failed	Result of the automatic BIS Self-Test <sup>2</sup> as well as the manually started DSC Self-Test, described on page 5-34.
<b>BIS Engine</b>		Gain High Pass blocked High Pass normal Noise	Detailed results of the DSC Self-Test.
S/N	Serial Number of the BIS Engine used.	<b>PIC</b>	
SW Rev	Installed Software Revision of the BIS Engine.	ID	With Sensor connected, the ID identifies the <b>class</b> of Sensors used. Supported classes: 7
Prot Rev	Protocol Revision of the BIS Engine used. Required for compatibility check between BIS Engine and BIS module.	<b>Sensor</b>	
FW Rev	Installed Firmware Revision of the BIS Engine.	S/N	Serial Number of the BIS Sensor used.
HW Rev	Hardware Revision of the BIS Engine used.	Code	Production related information.
Test passed / failed	Result of the automatic BIS Self-Test <sup>2</sup> .	Type	<b>Type</b> of Sensor used. Supported types: 1 (Adult Patient Sensor) 5 (Sensor Simulator)
<b>Diag data</b>	Information for internal use only.	Test passed / failed	Result of the automatic BIS Self-Test <sup>2</sup> .

1. If no number is shown behind S/N, please refer to the rear side of the BIS module.

2. Initiated by entering the Service Mode, switching Power On/Off or un-, replugging the BIS module.

## Compatibility Matrix

The following table indicates what revisions of the BIS Engine, DSC, PIC and what Sensor types are allowed to use with what revisions of the BIS Engine and BIS Module. Only the fields marked with a ● indicate a valid combination. Due to the low update frequency of this manual it is likely that a more recent version of this matrix has already been issued via a Service Note. Always refer to the latest version.

		Module FW Rev	BIS Engine SW Rev	BIS Engine Prot. Rev
		A.01.xx	2.xx	1.xx
BIS Engine SW Rev	2.xx	●		
BIS Engine Prot. Rev	1.xx	●	●	
DSC ID	9	●	●	●
PIC ID	7	●	●	●
Sensor type	1	●	●	●
	8	●	●	●

## Troubleshooting VueLink Module Problems

**NOTE**

For detailed troubleshooting information on the VueLink module, please refer to the documentation delivered with your external device driver.

For general testing of the VueLink module the following test procedure can be performed:

### M1032A VueLink Tests using VueLink Test Module

The VueLink Test Module (part number M1186-60510) is a plug-in module used to test M1032A VueLink modules in the Agilent V24/V26.

#### Test Procedure

The following steps are the procedure for testing a VueLink module using the VueLink Test Module. In order to run the test, the Test Module must be preselected ON in Config Mode. This means that the Test Module must be one of the devices made available for selection during configuration of the VueLink Module.

The test itself is carried out in Monitoring Mode. For information concerning the configuration of VueLink modules see the M1032A VueLink Module Handbook (part number M1032-9000B).

- Step 1** Plug the VueLink module into the module rack on the V24/V26.
- Step 2** Press the Setup key on the front of the VueLink module.
- Step 3** Press **Select Device**.
- Step 4** In the window that appears, select “Test Module” using the **Next Device** softkey. It is important to note which device driver was previously selected, in order to be able to reset it at the end of the test. (It will be labeled on the front of the VueLink Module.)
- Step 5** Press **Confirm** to store the selection and wait for the message “Switched to new device”.
- Step 6** Plug in the Test Module.
- Step 7** Connect the modules by plugging one end of the cable (part number M1032-61661) into the connector on the front of the VueLink Module, and the other end into the connector on the front of the Test Module.
- Step 8** Press **Setup VueLink** to make the Test Module Task Window appear on the screen.  
Note: The **Scale Wave** key is hollow and therefore cannot be selected.

The test module acts in the same way as an external device would, and sends signals to the VueLink module in both analog and digital form. The computer module checks these signals for validity, and then displays “passed” or “failed” on the screen.

The Task Window displays two waveforms, a triangular one and a rectangular one. These are displayed alternately and for a period of ten seconds each. The expected curve type is indicated below the wave.

There are two pairs of gridlines that indicate the permitted range for the max/min values of these waves. If all the data received by the test module is correct, the waves will lie within the specified ranges. If either limit of either wave falls outside the respective gridlines, then the module being tested is faulty regardless of the passed/failed messages.

The **Freeze Values** and **Update Values** softkeys are of no use in this test since **Freeze Values** would inhibit the update of the “Passed/Failed” messages.

When the test is complete:

- Step 1** Disconnect the cable that joins the Test Module to the VueLink module.
- Step 2** In Config Mode, ensure that the Test Module is set OFF, and the preselected devices are the same ones as before the test. Also, verify the settings for these devices.
- Step 3** Return to Monitoring Mode.
- Step 4** Press the Setup key on the front of the VueLink module and select the required device using the **Next Device** softkey.

---

**NOTE**

It is important to ensure that the preselected device drivers are configured exactly the same as they were before the test (including default settings).

## Performing Plug-In Module Self-Tests

The Agilent V24/V26 Series contains auto-tests and self-tests that are designed to demonstrate that the monitor is interacting with the plug-in modules.

### Objective

In order to meet the chapter's goals, you should be able to perform a plug-in module self-test and identify the normal outputs of a self-test.

### Concepts

This Agilent patient monitor has a module self-test which generates and displays test waveforms and corresponding numerics for all the modules that are connected through a rack and turned on. The test signals are displayed for about 30 seconds and then the display returns to the normal monitoring mode.

*The self-test ensures that the system is functioning correctly; it does not troubleshoot the system.*

The test signal will be displayed only if the system power-on sequence was successful and the module is plugged into a rack in the system and turned ON. Perform the following quick system check to verify that computer module, integral rack and plug-in modules are communicating properly before verifying the individual parameter modules.

### Performing a Quick System Check

You can verify that the System board, integral rack and modules are communicating properly by completing the following test.

**TEST** Press the ECG key on the front of the ECG module in a system that is turned ON.

**RESULT** Pressing the ECG key brings up the ECG Task Window and verifies that the System board and integral rack are communicating with the plug-in module.

If the plug-in module Task Window, waveform or numeric is missing from the display, the module may not be turned ON. Try pushing the key on the plug-in module to see if the system is communicating with the module. If the ECG module does not respond, perform the module self-test.

To turn a parameter ON, press the following key sequence:

#### Module Setup

- Parametr On/Off
- Select Parametr
- On/Off Setup

## Self-Test Procedure Overview

**Step 1** Choose a patient category (Adult/Pedi/Neo) by pressing the following key sequence:

**Module Setup**

→ **Config Sets**

→ **Change Pat Categ**

**Step 2** Display 30 seconds of the waveforms and numerics of all connected modules by pressing:

**Monitor Setup**

→ **Test Signals**

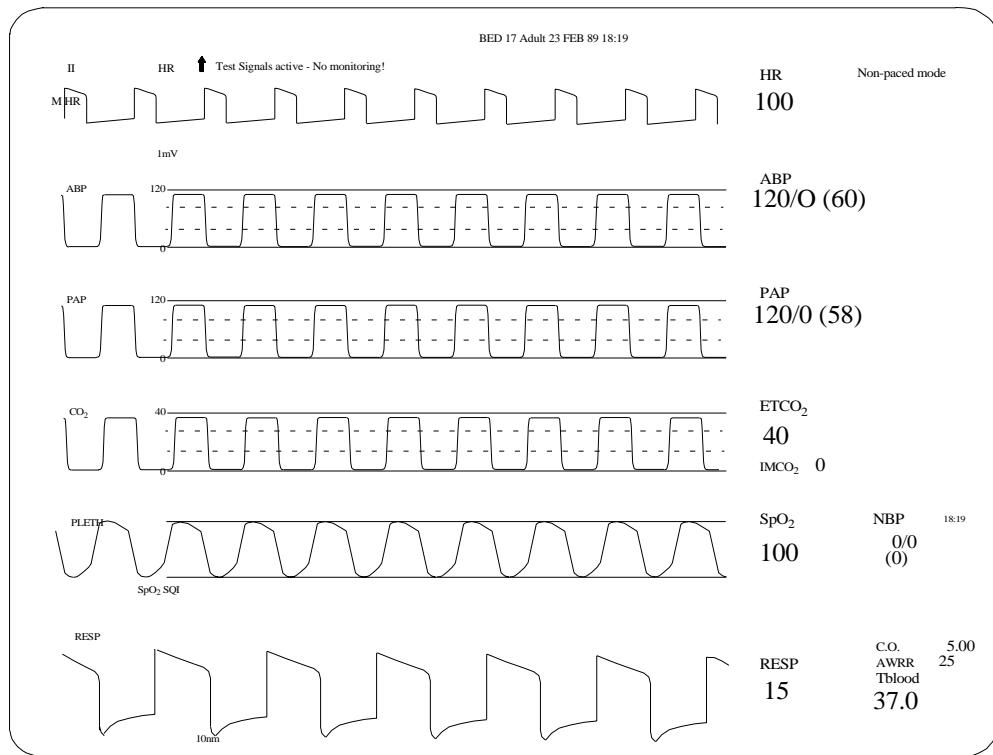
**Step 3** Repeat Step 2 as necessary to check the individual test waveforms and numerics for the category.

**Step 4** Use Step 1 to choose a new patient category and repeat Steps 2 and 3.

See the following table for test values.

**Table 5-17 System Self-Test Values**

Module	Test Numeric	Test Waveform
ECG	100 bpm in ADULT mode 125bpm in NEO/PED mode	Simulated Square Wave
RESP	15 rpm in ADULT mode 30 rpm in PEDI mode 55 rpm in NEO mode	Simulated Wave
Pressure Systolic	120 mmHg ADULT 60 mmHg PEDI/NEO	Simulated squarewave
Pressure Diastolic	0 mmHg ADULT 0 mmHg PEDI/NEO	Simulated squarewave
SpO <sub>2</sub>	100%	No Wave
Pleth	Wave on display	Simulated wave
Cardiac Output Blood Temp Inj Temp	5 l/min (+0.1 l/min) 37°C 0°C	No wave
tcpO <sub>2</sub>	60 mmHg (8.0 kPa)	No wave
tcpCO <sub>2</sub>	40 mmHg (5.3 kPa)	No wave
ETCO <sub>2</sub>	40 mmHg (6.0 kPa)	Simulated squarewave
IMCO <sub>2</sub>	0 mmHg (0.0 kPa)	Simulated squarewave
AWRR	25 rpm	
Temperature	40°C (104°F)	No wave



**Example of an extended Self-Test display showing all possible waveforms**

Troubleshooting Plug-in Modules

*ECG test signals are rectangular pulses, which represent beat-to-beat heart rate, and are not the same as the ECG signals expected from a patient.*

## Performing the ECG or ECG/RESP Module Self-Test

**Auto Check:** None.

**Self-Test:** The ECG and ECG/RESP self-test may be performed at any time as the lead selector and pace pulse detection are inhibited during the check. The module will produce ECG test signals at the beginning of the processing circuitry, and process the test signals in the same way patient signals are processed. The test signals last about 30 seconds and then the display returns to the normal monitoring mode.

**TEST**      Press **Monitor Setup** → **Test Signals**

**RESULT**      If the module is functioning correctly, the following heart rate and respiration are displayed without the alarms being activated:

<b>ECG</b>	100 bpm in ADULT mode 125 bpm in NEO/PEDI mode
------------	---

<b>RESP</b>	15 rpm in ADULT mode 30 rpm in PEDI mode 55 rpm in NEO mode
-------------	---

*The pressure waveform provided is not the same as the waveform which would be expected from a patient.*

## Performing the M1006A/B Pressure Module Self-Test

**Auto Check:** The check for these modules is started every time the system is switched ON and checks the complete module circuitry, including the sensitivity detection circuit.

**Self-Test:** The test signals last about 30 seconds and then the display returns to the normal monitoring mode.

The M1006A Pressure self-test may be performed at any time as the input switch switches the CAL divider to 0 mmHg, and the pressure test signals bypass the sensitivity detection circuit. From here, the signals are processed in the same way as the patient signals.

The M1006B Pressure self-test may be performed at any time, as the signal is output from a microcontroller. From here, the test signal is processed in the same way as a patient signal, testing the complete signal path from the module to the display.

**TEST**      Press **Monitor Setup** → **Test Signals**

**RESULT**      If the module is functioning correctly, the following systolic and diastolic pressures are displayed without the alarms being activated:

<b>Systolic</b>	120 mmHg ADULT 60 mmHg PEDI/NEO
-----------------	------------------------------------

<b>Diastolic</b>	0 mmHg ADULT 0 mmHg PEDI/NEO
------------------	---------------------------------

**CAUTION**

**For the M1006A/B Pressure Modules with analog output (Option #CO1), do not attempt defibrillation unless pump cable is connected at both ends or disconnected entirely. The signal to the balloon pump stops when a self-test is in progress or in Demo, Configuration or Service Modes.**

*This module has no test waves or numerics.*

*The SpO<sub>2</sub>/Pleth test waveform is a Pleth rectangular wave which represents the signal from the photodiode in the SpO<sub>2</sub> transducer assembly.*

**Performing the NBP Module Self-Test**

**Auto Check:** The NBP module performs a check periodically during operation.

**Self-Test:** None.

**Performing the SpO<sub>2</sub>/Pleth Module Self-Test**

**Auto Check:** None.

**Self-Test:** The SpO<sub>2</sub>/Pleth module self-test may be performed at any time. The integral waveform generator in the module produces test signals using the current driver at the beginning of the processing circuitry. The test signals are processed in the same way as patient signals are processed. The test signals last about 30 seconds and then the display returns to the normal monitoring mode.

**TEST**      Press **Monitor Setup** → **Test Signals**.

**RESULT**      If the module is functioning correctly, the following derived values and waveform are displayed without the alarms being activated:

<b>SpO<sub>2</sub></b>	100%
<b>Pleth</b>	Wave height after auto gain is 100% of scale height
<b>Pulse Rate</b>	100 bpm in ADULT mode 125 bpm in NEO/PEDI mode

*This module only displays numerics.*

**Performing the Cardiac Output Module Self-Test**

**Auto Check:** None.

**Self-Test:** The Cardiac Output module test may be performed at any time. The test signal lasts about 30 seconds and then the display returns to the normal monitoring mode.

**TEST**      Press **Monitor Setup** → **Test Signals**.

**RESULT**      If the module is functioning correctly, the following derived values will be displayed without the alarms being activated:

<b>C.O.</b>	5.0 liters/min ( $\pm 0.1$ liters/min)
<b>TBlood</b>	37C $\pm 0.1$ C

*This module only displays numerics.*

T<sub>inj</sub>                  0C ± 0.1C

## Performing the tcpO<sub>2</sub>/tcpCO<sub>2</sub> Module Self-Test

**Auto Check:** The check is performed automatically when the system is switched on, during calibration, and continuously when no transducer is connected. When the auto check fails, the INOP message: Equipment Malfunction is given (refer to the Troubleshooting Chapter in this manual for troubleshooting details).

**Self-Test:** The tcpO<sub>2</sub>/tcpCO<sub>2</sub> module self-test may be performed at any time. The test signal lasts about 30 seconds and then the display returns to the normal monitoring mode.

**TEST**      Press **Monitor Setup** → **Test Signals**

**RESULT**      If the module is functioning correctly, the following numerics are displayed without the alarms being activated:

tcpO <sub>2</sub>	60 mmHg (8.0 kPa)
tcpCO <sub>2</sub>	40 mmHg (5.3 kPa)

---

### CAUTION

**Radiated immunity:** If operating under conditions according to EN 60601-1-2 up to 1 V/m electrical field strength, the following deviations in the measurements could occur: tcpO<sub>2</sub> 2 mmHg or less, tcpCO<sub>2</sub> 1 mmHg or less. It is recommended to avoid the use of electrically radiating devices in close proximity to a tcpO<sub>2</sub>/tcpCO<sub>2</sub> monitor.

---

*This module only displays a numeric.*

The simulated CO<sub>2</sub> wave is provided on the display with the numerics.

## Performing the CO<sub>2</sub> Module Self-Test

**Auto Check:** None.

**Self-Test:** The self-test may be performed at any time. The test signals last about 30 seconds, and then the display returns to the normal monitoring mode.

**TEST**      If a transducer is connected to the module, the following conditions must be met:

- The motor in the transducer is running.
- No heater malfunction is reported.

Press **Monitor Setup** → **Test Signals**.

**RESULT**      If the module is functioning correctly the values will be displayed without the alarms being activated and should read as follows:

ET CO <sub>2</sub>	40 mmHg (6.0kPa)
IMCO <sub>2</sub>	0 mmHg (0.0kPa)

**AWRR**                  25 rpm

## Performing the Temperature Module Self-Test

**Auto Check:** None.

*This module only displays a numeric.*

**Self-Test:** The Temperature module self-test may be performed at any time as the switch network switches to the reference resistors for the duration of the check. The system connects the reference resistors to the beginning of the processing circuitry, and processes this test value in the same way as the patient values are processed. The test signals last about 30 seconds and then the display returns to the normal monitoring mode.

**TEST**                  Press **Monitor Setup** → **Test Signals**.

**RESULT**                  If the module is functioning correctly, the following temperature will be displayed without the alarms being activated:

**Temp**                  40 C ( $\pm 0.1C$ )

## Performing the Blood Analysis Module Self-Test

**Auto Check:** The Blood Analysis Module performs a check when the system is switched on.

**Self-Test:** The Self-Test with the External Simulator M3634A may be performed at any time.

**TEST**                  Insert the External Simulator into the cartridge slot of the module.

**RESULT**                  Either PASS or FAIL will be displayed on the Monitor to indicate whether the module has passed the self-test or not. If the module fails the self-test, try the procedure again. If it fails again, wait half an hour and then try the procedure again. If the module continues to fail the self-test the module should be replaced.

## Performing the Recorder Module Self-Test

**Auto Check:** The recorder module performs a check when it is plugged in to the front-end rack of the system.

*The recorder module produces a sequence of LED flashes when tested.*

**Self-Test:** The Recorder Module check may be performed at any time.

**TEST**                  Turn on the system power and plug in the recorder module.

**RESULT**                  The LED on the front panel indicates whether the module has passed the self-test by flashing.

**Two flashes**                  Module has passed check.

**One flash**                  Module failed self-test. Take the module out and try the procedure again to make sure there is a good connection.

*Refer to M1032A  
VueLink Module  
Handbook for  
further service details  
on the VueLink  
Modules.*

<b>No flash</b>	Module processors are not working properly and the module should be replaced.
-----------------	---

## **Performing the VueLink Module Self-Test**

**Auto Check:** The VueLink Module performs an automatic check when the module is plugged in to the module rack of the system.

**Self-Test:** None.

# Chapter 6 Repairing the Agilent Model V24

## Objective

After reading this chapter and completing the Practice Exercise you will be able to **remove** and **replace** the following Agilent Model V24 major assemblies:

- Front Housing Assembly and major components
- Rear Housing Assembly and major components

## In this chapter

The removal and replacement procedures for the instrument are easy to complete when following the step-by-step procedures. There are three parts to this chapter; namely, disassembly, reassembly and practice exercises. At the end of this chapter complete the practice exercise to check your understanding of how to remove and replace the key field replaceable assemblies.

Topics in this Chapter	See Page	Topics in this Chapter	See Page
<b><i>Front Housing Removal Procedures</i></b>	6-2	<b><i>Front Housing Replacement Procedure</i></b>	
Removing the Front Housing Assembly	6-3	Replacing the Front Housing Assembly	6-16
Removing the Flat Panel Display Assembly	6-5	Replacing the Flat Panel Display Assembly	6-18
Removing the Front Housing Keypad	6-6	Replacing the Front Housing Keypad	6-19
Removing the Flat Panel Adapter Board	6-7	Replacing the Flat Panel Adapter Board	6-20
Removing the Flat Panel Backlight Tube	6-8	Replacing the Flat Panel Backlight Tube	6-21
<b><i>Rear Housing Removal Procedures</i></b>		<b><i>Rear Housing Replacement Procedures</i></b>	
Removing the System Board	6-10	Replacing the Power Supply Assembly	6-23
Removing the Power Supply Assembly	6-12	Replacing the System Board	6-26
		<b><i>Practice Exercises</i></b>	6-28

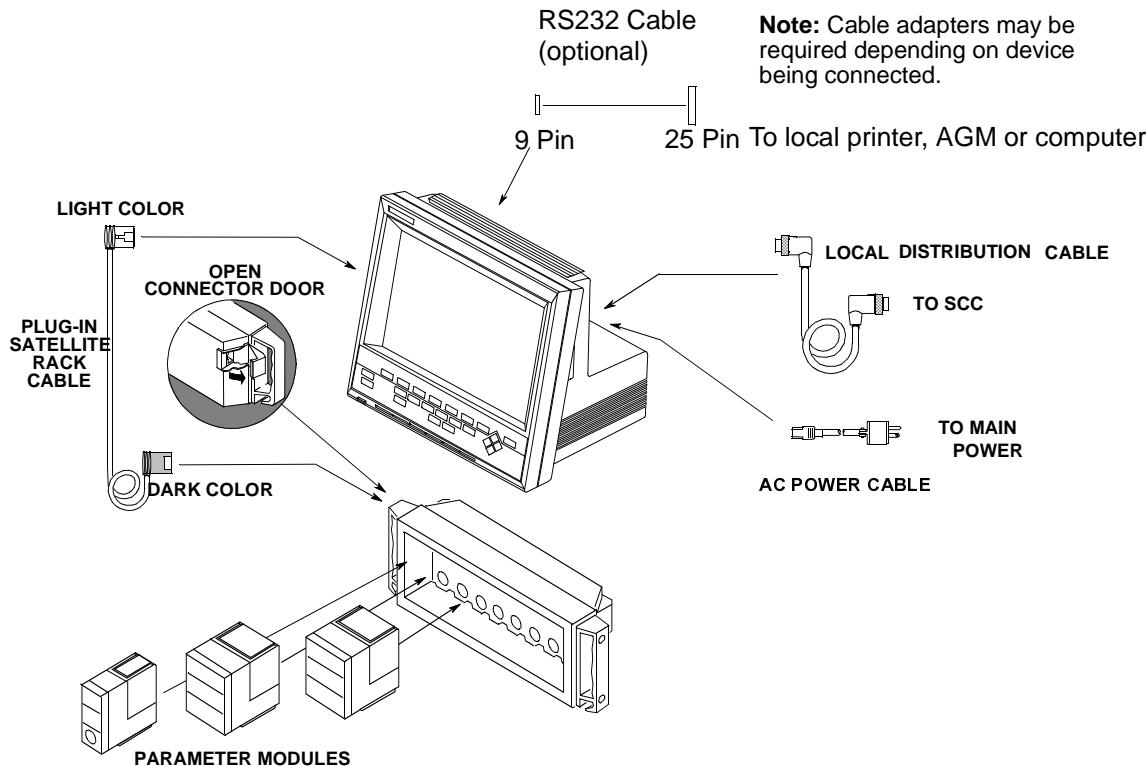
## Removal Procedures

This section presents procedures to disassemble the instrument to the extent required to remove and replace faulty assemblies. Do not further disassemble the product past the point described in these procedures.

### **WARNING**

High Voltage - Voltages dangerous to life are present in the instrument. Do not perform any disassembly procedures (other than parameter module removal) with power applied to the instrument. Failure to adhere to this warning could cause serious injury or death.

Before doing any disassembly, turn power off and disconnect the Local Distribution Cable, AC power cable, Plug-in Satellite Rack cable, Defib sync cable, and RS232 Cable (where appropriate).

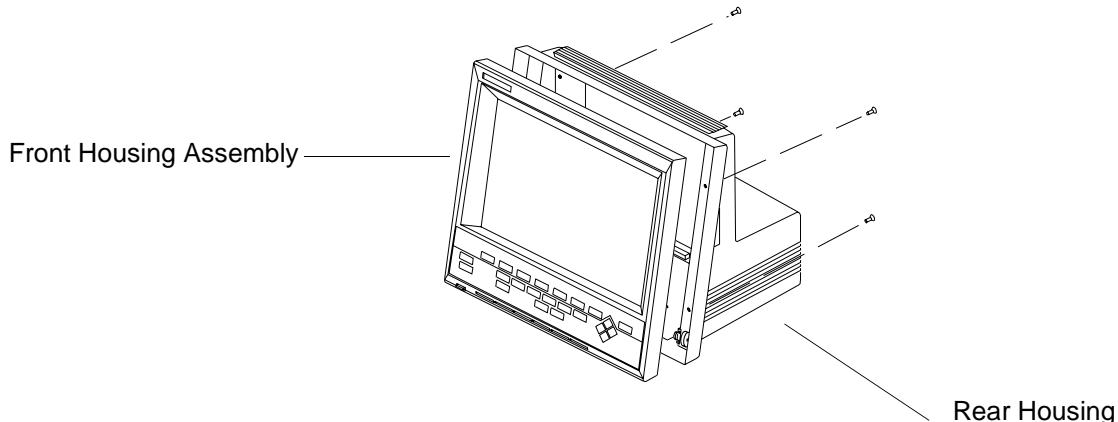


### **Tools Required:**

- small flat-bladed screwdriver
- small jeweler-sized Phillips screwdriver
- Pozidrive screwdriver (medium)

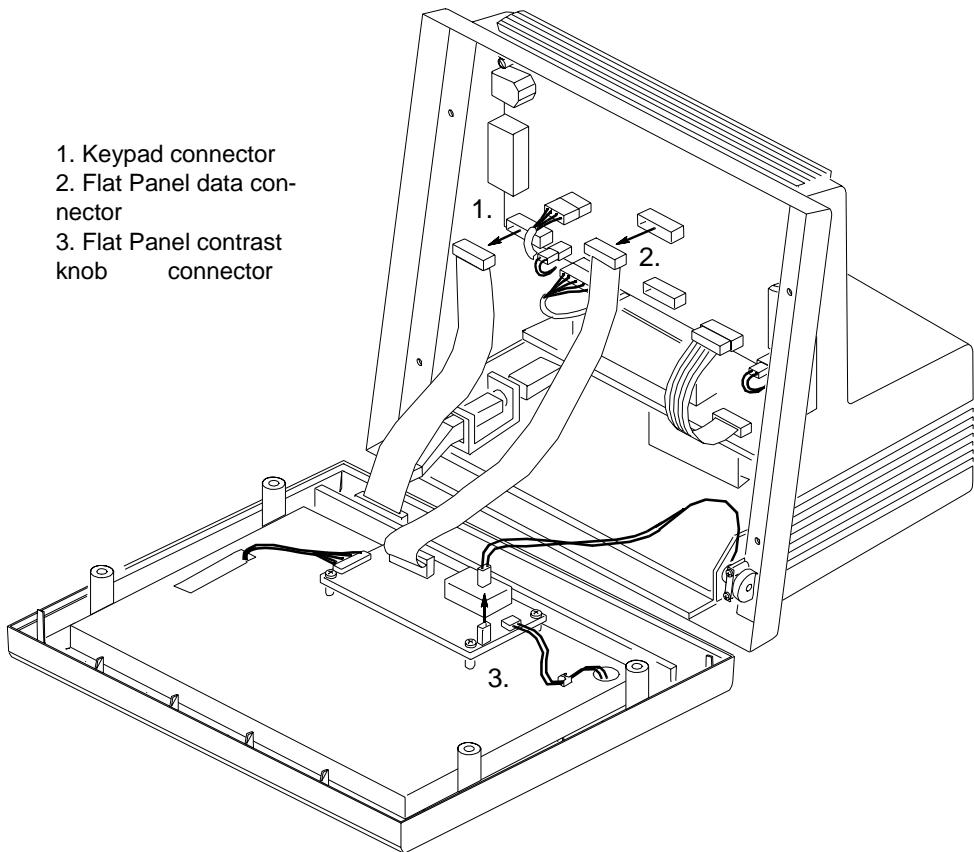
## **Removing the Front Housing Assembly**

- 1** Remove 4 screws from the rear of the Front Housing Assembly. Separate Front Housing Assembly from Rear Housing and lay it down on a flat surface.



- 2** Disconnect the Keypad cable from the System Board.
- 3** Disconnect the Flat Panel data cable from the Flat Panel Adapter Board.
- 4** Disconnect the contrast knob connector from the Flat Panel Adapter Board.

**NOTE:** If your Agilent M1205A uses the SDN Daughter Card for SDN connectivity, some hardware will be different than what is shown in the illustrations in this chapter. Refer to Appendix A for information on the Agilent M1205A with the SDN daughter card.

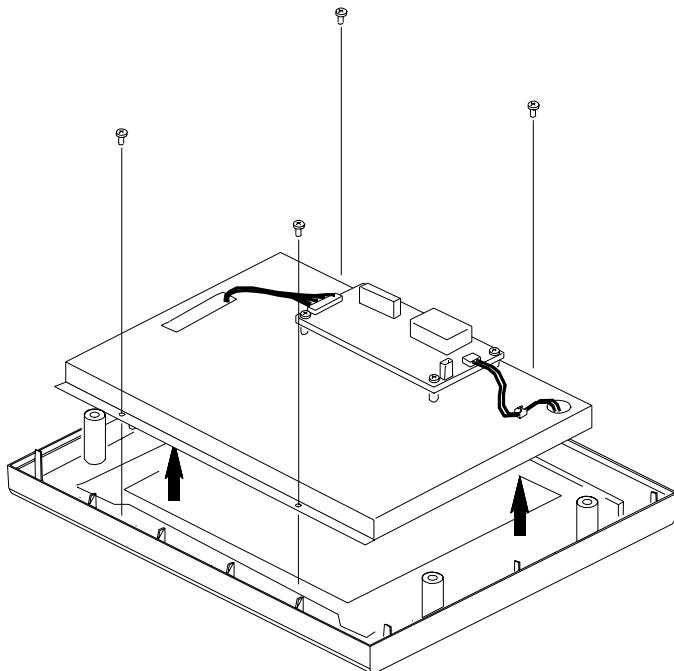


## Removing the Flat Panel Display Assembly

### CAUTION

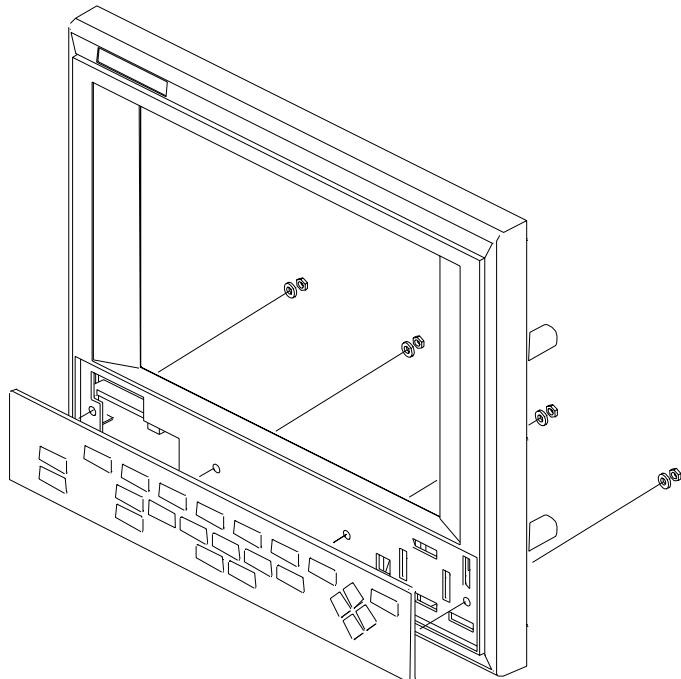
Fingerprints and dirt between the Flat Panel Display and plastic antiglare screen show up prominently during instrument operation. Take care not to touch the Flat Panel screen or the inside of the clear plastic antiglare screen. Remove any fingerprints or dirt using a non-residue-forming cleaner (such as alcohol) and a lint-free cloth.

- 1 Remove the Front Housing Assembly as described above.
- 2 Remove the 4 screws connecting the Flat Panel Bracket (containing the Flat Panel) to the Front Housing.
- 3 Grasp the sides and lift upwards to remove the Flat Panel Bracket from the Front Housing.



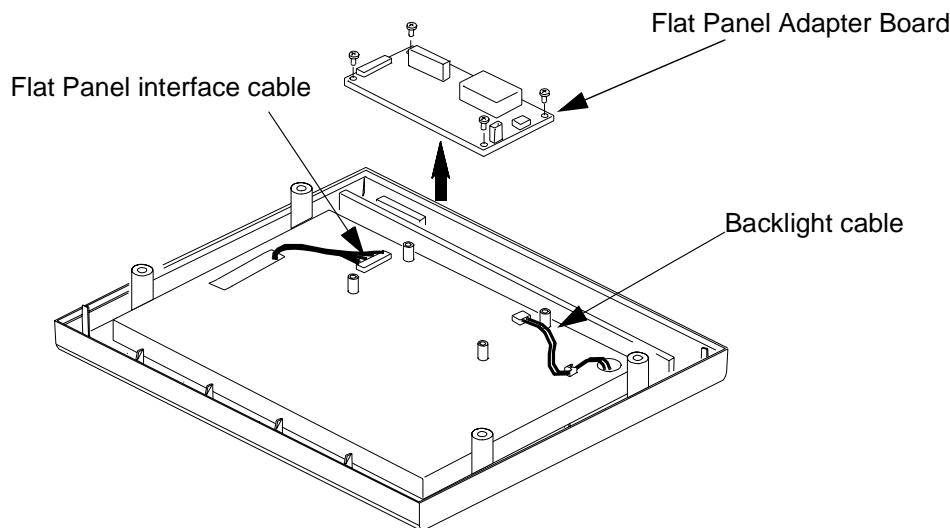
## **Removing the Front Housing Keypad**

- 1** Remove power to the instrument and disconnect the AC power cord.
- 2** Remove the Front Housing Assembly and keypad ribbon cable.
- 3** Remove four nuts securing keypad to the Front Housing.
- 4** Remove keypad from Front Housing.



## Removing the Flat Panel Adapter Board

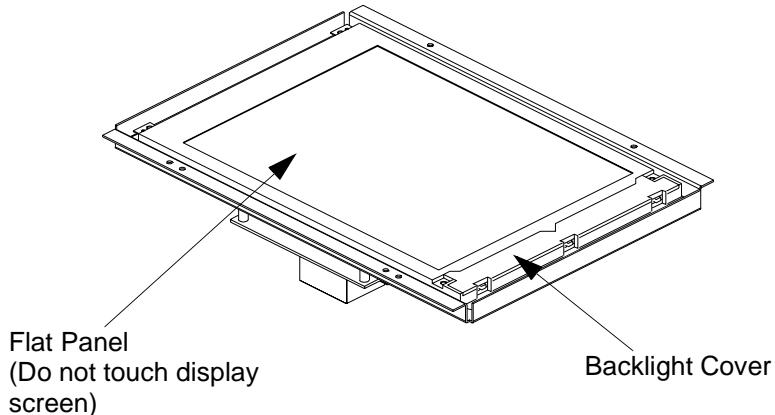
- 1 Disconnect the Flat Panel interface cable from the Flat Panel Adapter Board.
- 2 Disconnect the Backlight cable from the Flat Panel Adapter Board.
- 3 Remove the 4 screws connecting the Flat Panel Adapter Board to the Flat Panel Bracket.



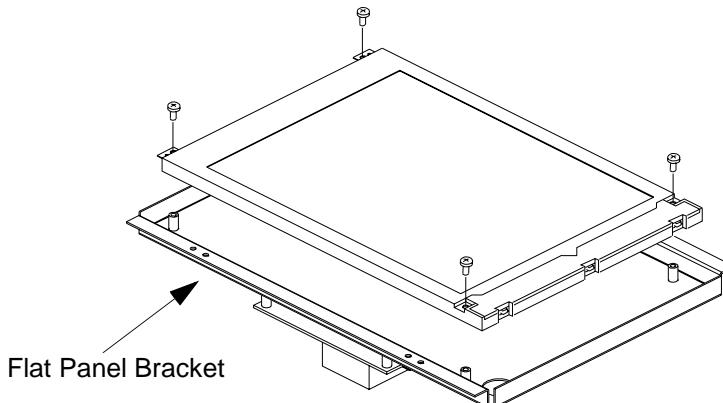
- 4 Lift the Flat Panel Adapter Board off of the Flat Panel Bracket.

## **Removing the Flat Panel Backlight Tube**

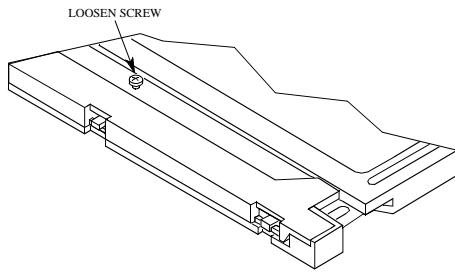
- 1** Remove the Flat Panel Display Assembly as described above
- 2** Disconnect Flat Panel interface cable from Flat Panel Adapter Board.
- 3** Disconnect Flat Panel Backlight connector from Flat Panel Adapter Board.
- 4** Turn the Flat Panel Bracket over and lay on a flat surface (Display side up).



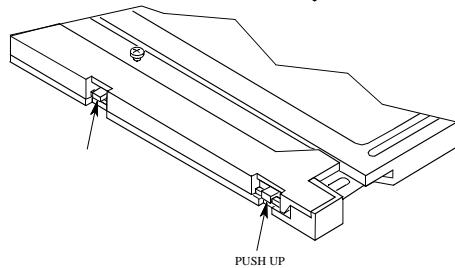
- 5** Remove 4 screws securing the Flat Panel to the Flat Panel Bracket.



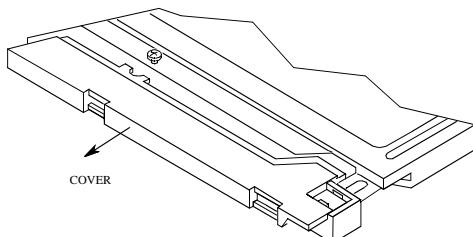
**6** Loosen screw connecting the Backlight cover to the Flat Panel using a jeweler size Phillips screw driver, but do not remove completely.



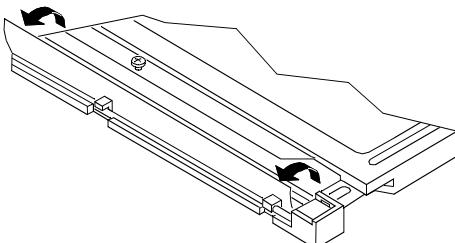
**7** Push up on 3 tabs to release cover.



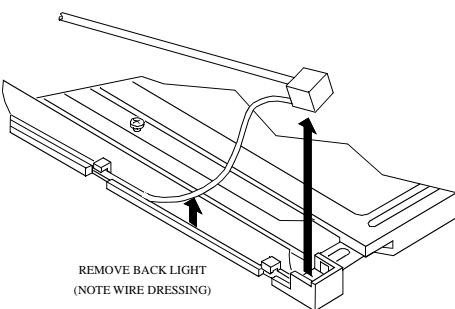
**8** Slide cover forward and up to remove



**9** Open the Reflector film



**10** Remove the Backlight with wiring harness and rubber boots.



### Notes:

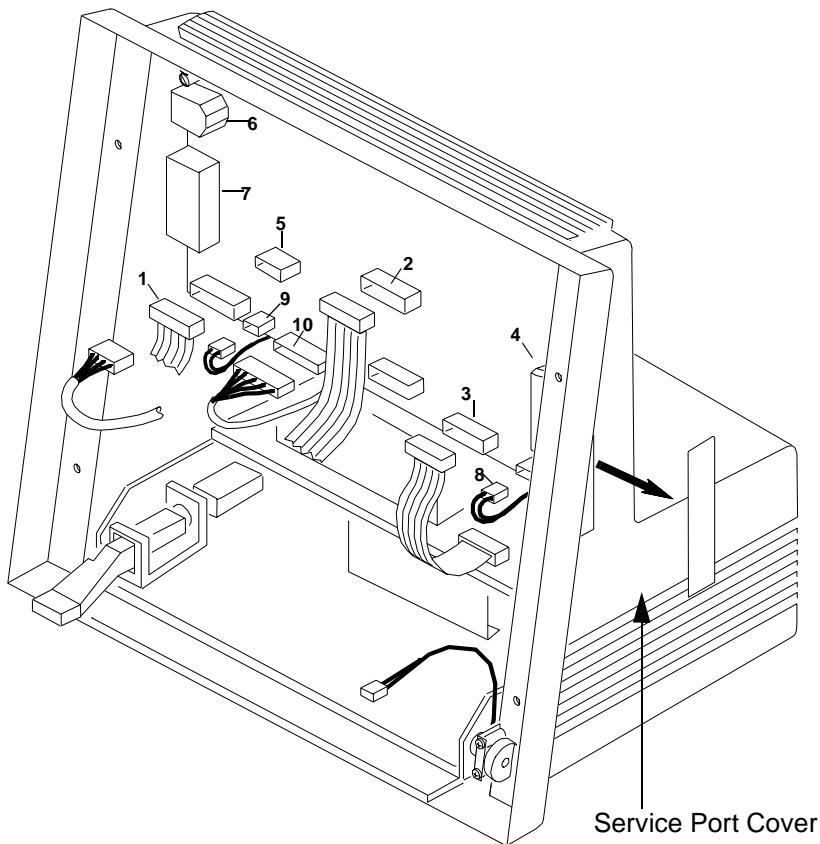
1. The longer length Backlight wire is placed along the Backlight in the channel provided in the housing. When re-installing or replacing the backlight, insure that the longer wire is placed in the channel as shown. If the Backlight is installed backwards, then the wire is too short to reach the mating connector on the Flat Panel Adapter Board.
2. Do not touch fluorescent tube when removing or installing the backlight as oil from finger prints will shorten the operating life of the tube.

## **Removing the System Board**

- 1** Remove the Front Housing Assembly.
- 2** Disconnect the cables from the System Board as shown below.

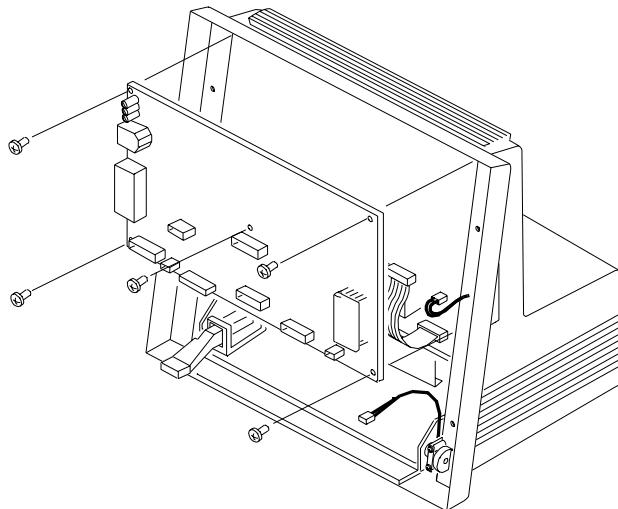
### **System Board interface connectors:**

1. Keypad connector
2. Flat Panel Data Connector
3. 5V and 12V power supply connector
4. Service ports (not cabled)
5. SDN interface cable
6. Defib sync connector (not cabled)
7. Front-end link connector
8. Speaker connector
9. 60 VDC power supply connector
10. RS232 connector (with option J13)



- 3** Using a small (1/8" inch) flat-blade screwdriver, pry the service port cover from the Rear Housing and remove.

- 4** Remove the 5 screws securing the System Board to the Rear Housing.



- 5** Remove the System Board from the Rear Housing.

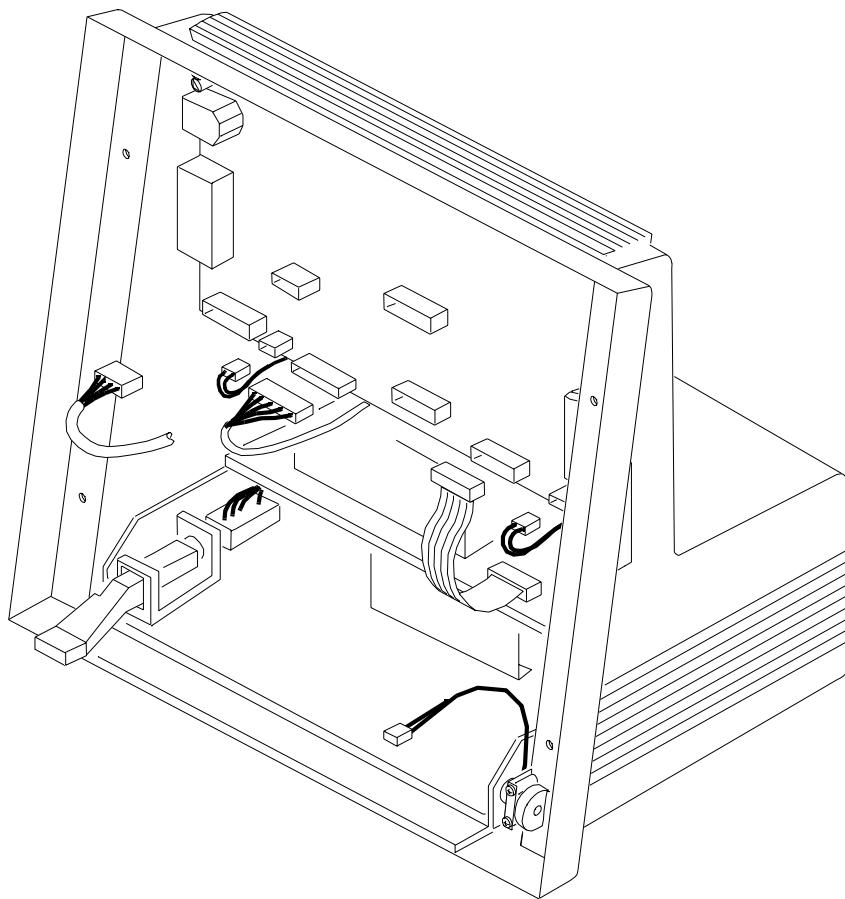
## **Removing the Power Supply Assembly**

### **CAUTIONS**

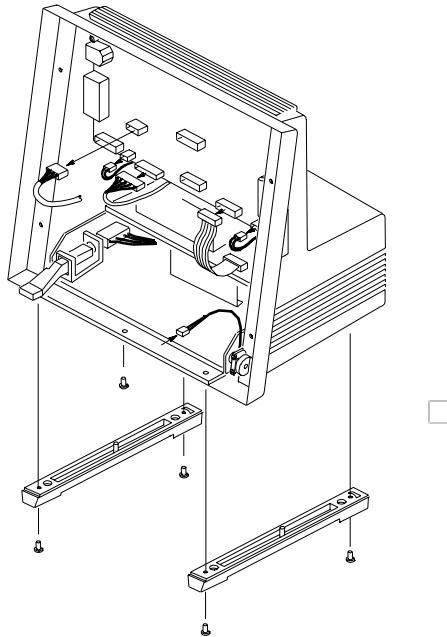
**A. Power leakage to ground may occur due to dirty cable connectors. The power supply cable connectors should be verified for cleanliness after removing and before replacing the power supply.**

**B. You should perform the leakage current test described in "Testing & Maintaining the Agilent V24/V26 Series" whenever removing and replacing the power supply. A ground fault may occur causing a user safety concern.**

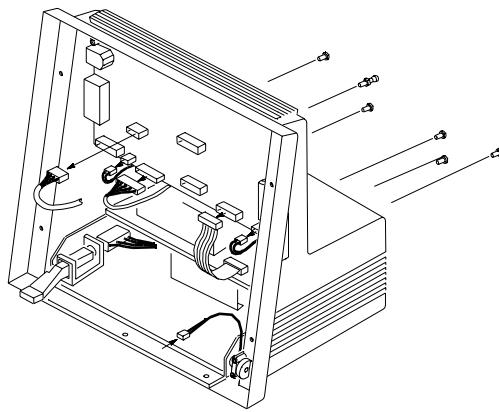
- 1** Turn power off to the instrument and disconnect the AC power cord.
- 2** Remove the Front Housing Assembly.
- 3** Disconnect all cables from the System Board as shown



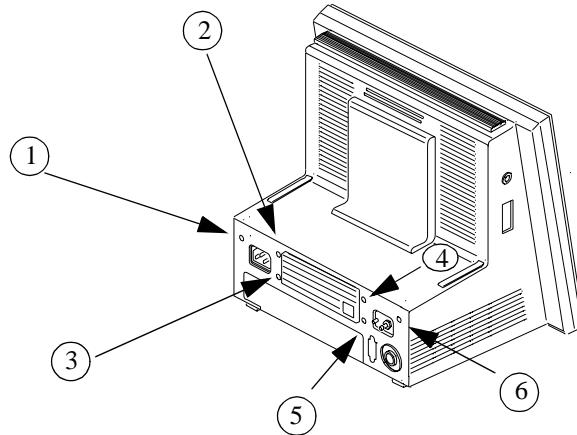
- 4 From underneath the instrument, remove 4 screws securing the instrument feet to the rear housing. Remove feet.



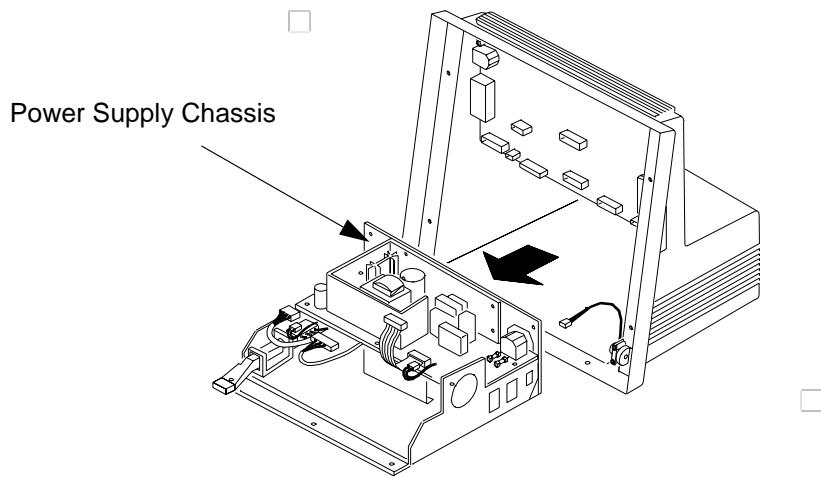
- 5 From underneath the instrument, remove one retaining screw at the front center of the rear housing.
- 6 Depending on the type of rear housing, remove the following:
  - On rear housings with a serial prefix <3608, remove the 5 screws and ground lug at the rear of the instrument as shown below.



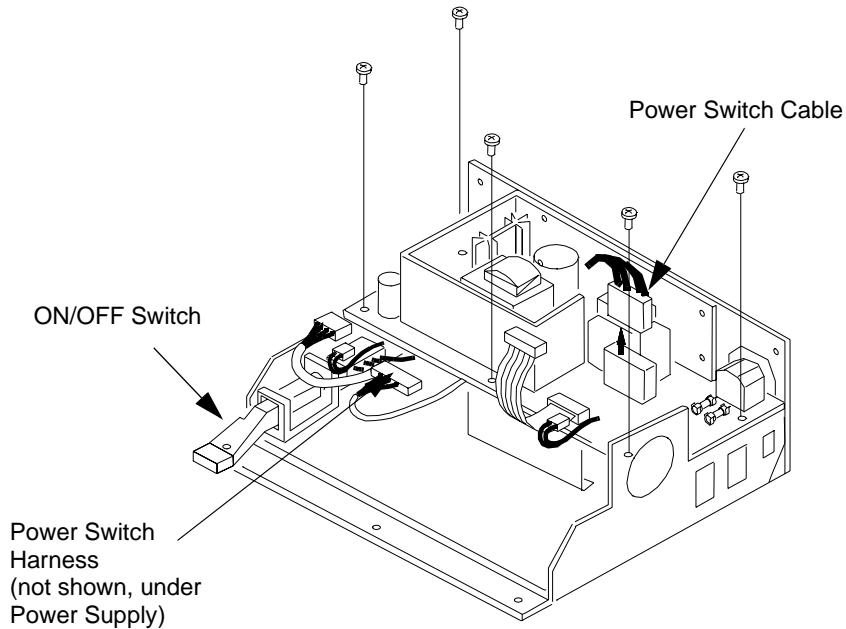
- On rear housings with a serial prefix code of  $\geq 3608$ , remove the 6 screws at the rear of the instrument.



7 Slide the Power Supply Chassis Assembly from the front of the Rear Housing.



- 8** Remove 5 screws connecting the Power Supply Board to the chassis.



- 9** Disconnect the Power Switch Cable from the Power Supply Board.

- 10** Lift Power Supply Board off the chassis.

## Reassembly Procedures

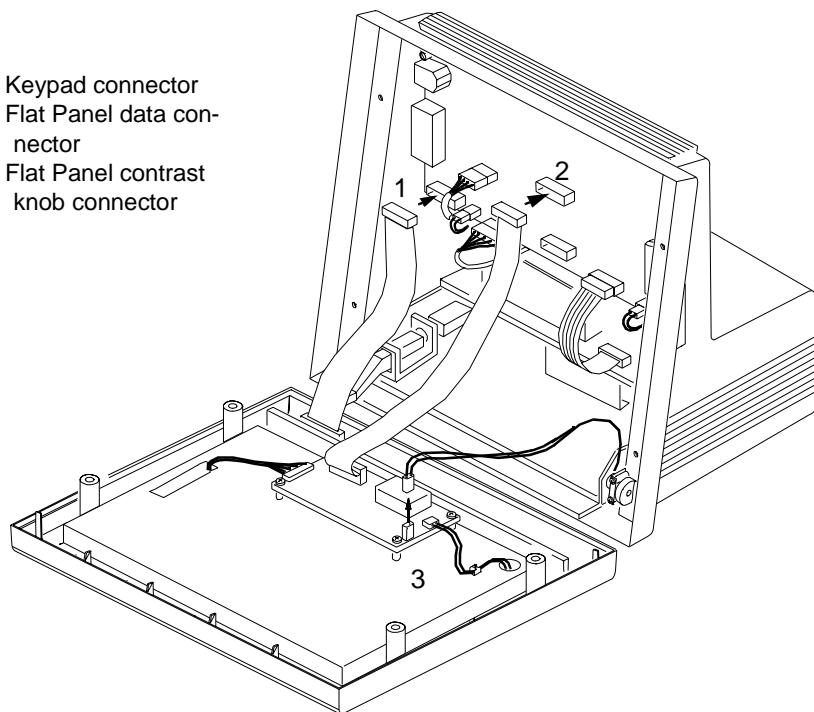
The procedures described in this section begin with the instrument's power turned off, and the instrument is disassembled.

**WARNING**

**High Voltage - Voltages dangerous to life are present in the instrument. Do not perform any assembly procedures (other than parameter module installation) with power applied to the instrument. Failure to adhere to this warning could cause serious injury or death.**

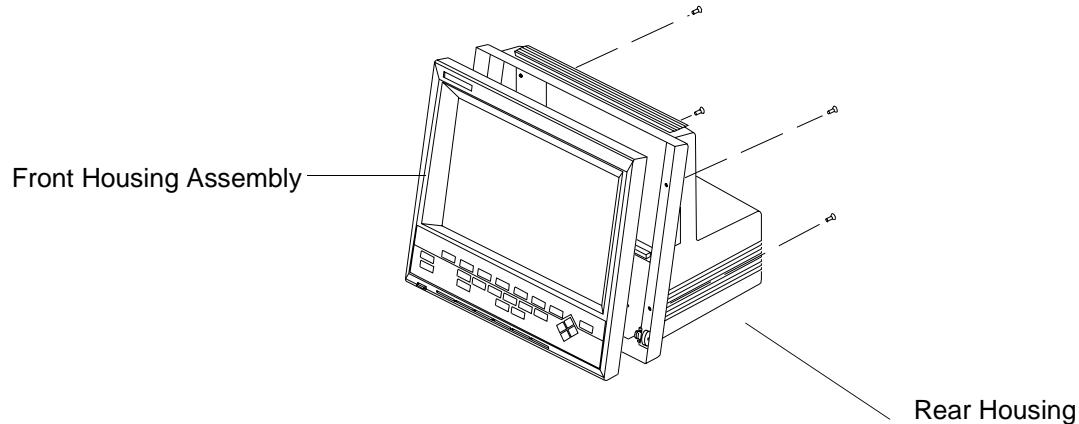
### Replacing the Front Housing Assembly

- 1 Connect the contrast knob connector to the Flat Panel Adapter Board.



- 2 Connect the Flat Panel data cable to the Flat Panel Adapter Board.
- 3 Connect the Keypad cable to the Keypad.

- 4** Attach the Front Housing Assembly to the Rear Housing. Replace the 4 screws at the rear of the Front Housing Assembly.



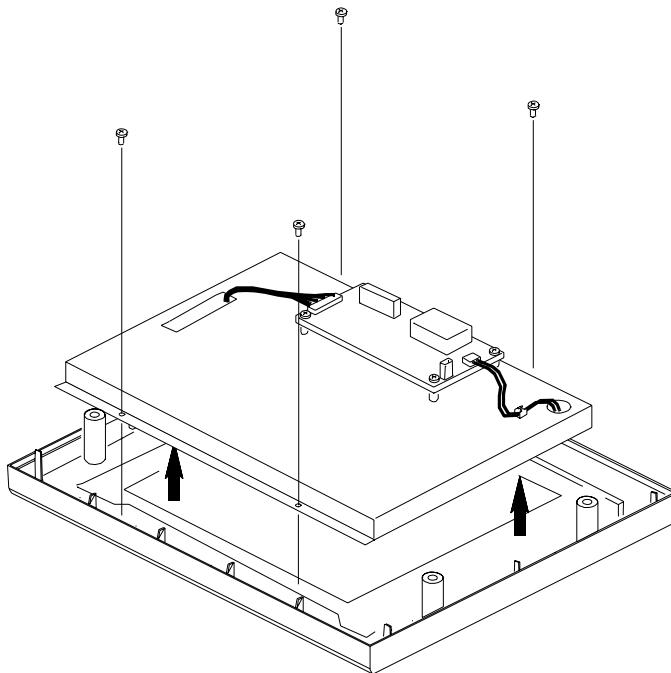
- 5** Connect the Local Distribution Cable, AC power cable, Plug-in Satellite Rack cable, Defib sync cable, and RS232 Cable (where appropriate).

## Replacing the Flat Panel Display Assembly

### **CAUTION**

Fingerprints and dirt between the Flat Panel Display and plastic antiglare screen show up prominently during instrument operation. Take care not to touch the Flat Panel screen or the inside of the clear plastic antiglare screen. Remove any fingerprints or dirt using a non-residue-forming cleaner (such as alcohol) and a lint-free cloth.

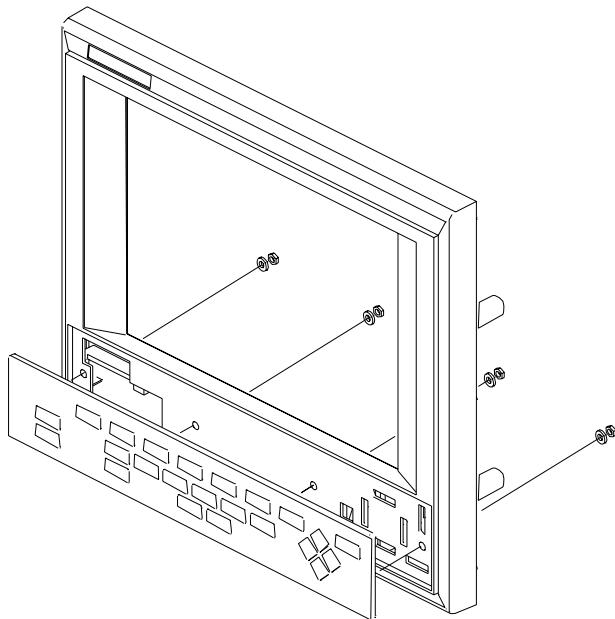
- 1** Grasp the sides and insert the Flat Panel Bracket (containing the Flat Panel) into the Front Housing.



- 2** Attach the Flat Panel Bracket to the Front Housing using the four screws provided.
- 3** Install the Front Housing Assembly.

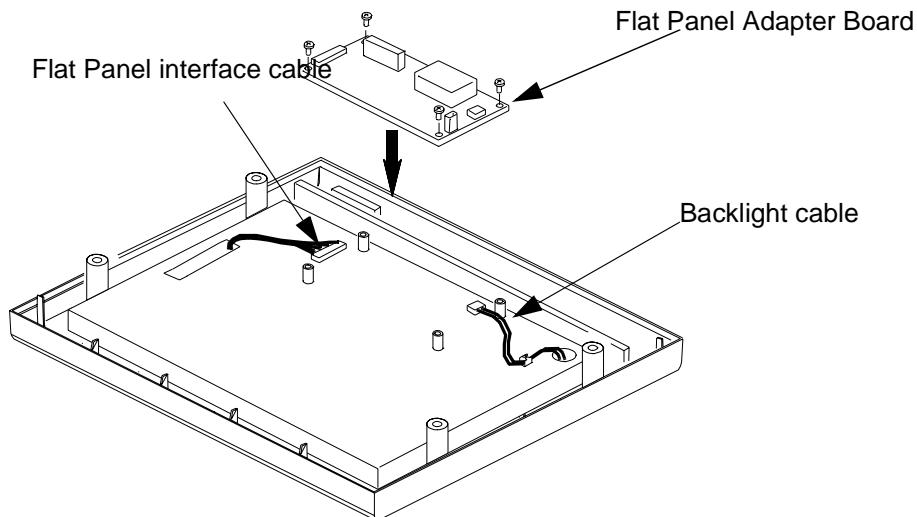
## **Replacing the Front Housing Keypad**

- 1** Insert the keypad onto the Front Housing.
- 2** Replace four nuts securing keypad to the Front Housing.
- 3** Install the Front Housing Assembly



## **Replacing the Flat Panel Adapter Board**

- 1** Place the Flat Panel Adapter Board over the 4 spacers attached to the Flat Panel Bracket.



- 2** Replace the 4 screws connecting the Flat Panel Adapter Board to the Flat Panel Bracket.
- 3** Connect the Backlight cable to the Flat Panel Adapter Board.
- 4** Connect the Flat Panel interface cable to the Flat Panel Adapter Board.
- 5** Install the Front Housing Assembly.

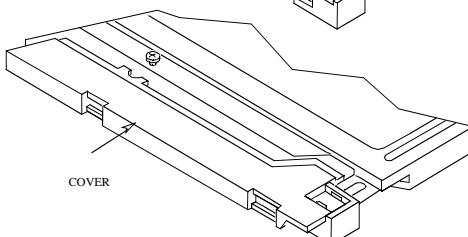
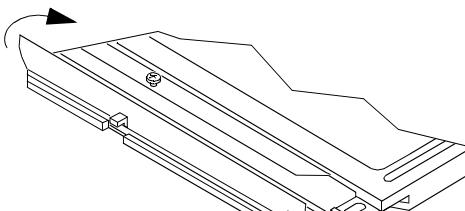
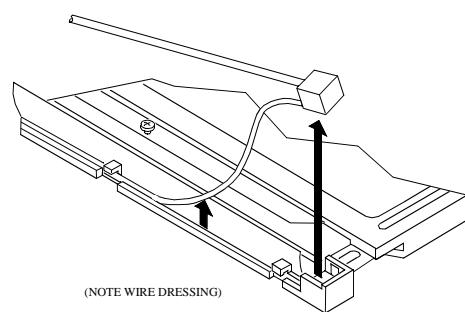
## Replacing the Flat Panel Backlight Tube

**1** Install the Flat Panel Backlight Tube.

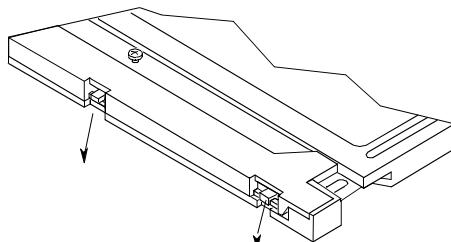
### Notes:

1. The longer length Backlight wire is placed along the Backlight in the channel provided in the housing. When re-installing or replacing the backlight, insure that the longer wire is placed in the channel as shown. If the Backlight is installed backwards, then the wire is too short to reach the mating connector on the Flat Panel Adapter Board.
2. Do not touch fluorescent tube when removing or installing the backlight as oil from finger prints will shorten the operating life of the tube.

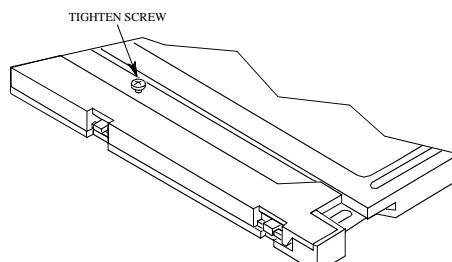
**2** Close the Reflector film.



**3** Slide cover back and in to install.

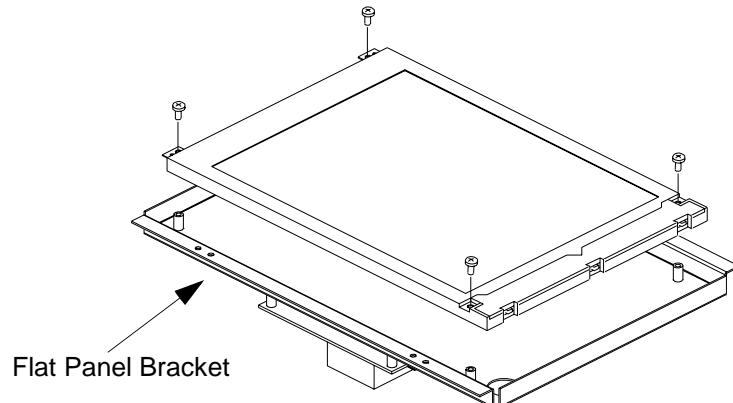


**4** Push down on 3 tabs to secure cover.



**5** Tighten screw connecting the Backlight cover to the

**6** Replace 4 screws securing the Flat Panel to the Flat Panel Bracket.



**7** Install the Flat Panel Display Assembly.

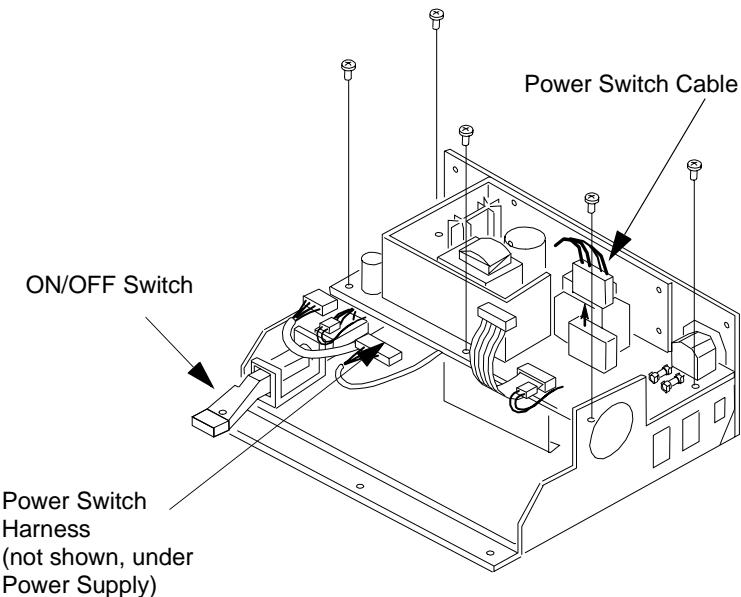
## Replacing the Power Supply Assembly

### **CAUTION**

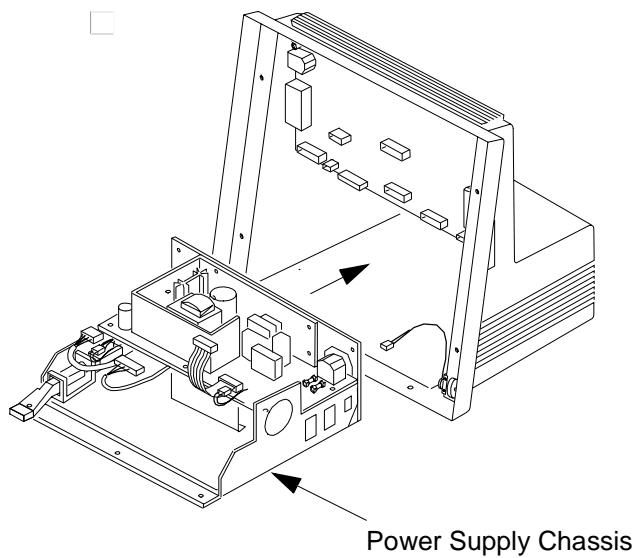
**A. Power leakage to ground may occur due to dirty cable connectors. The power supply cable connectors should be verified for cleanliness after removing and before replacing the power supply.**

**B. You should perform the leakage current test described in Chapter 2 whenever removing and replacing the power supply. A ground fault may occur causing a user safety concern.**

- 1** Connect the Power Switch Cable to the Power Supply Board.
- 2** Place Power Supply Board on the chassis.
- 3** Replace the 5 screws connecting the Power Supply Board to the chassis.

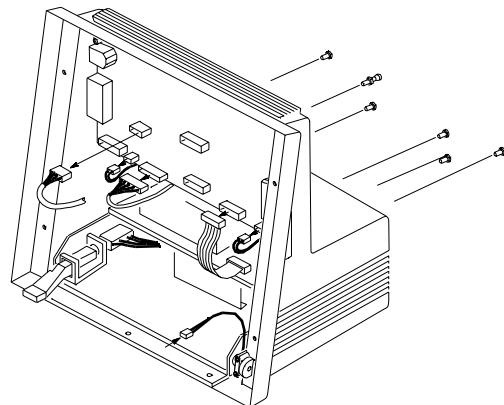


- 4** Slide the Power Supply Chassis Assembly into the front of the Rear Housing.

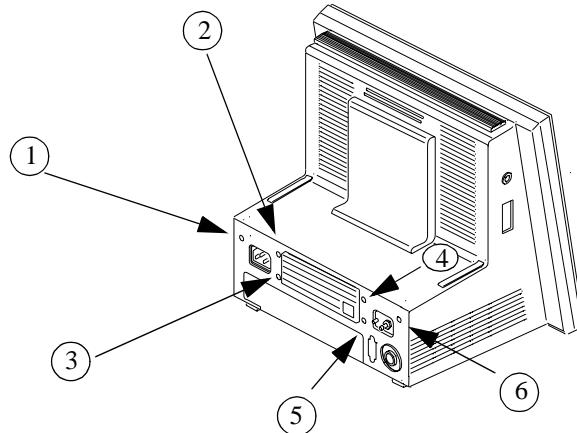


- 5** Depending on the type of Rear Housing, install the following:

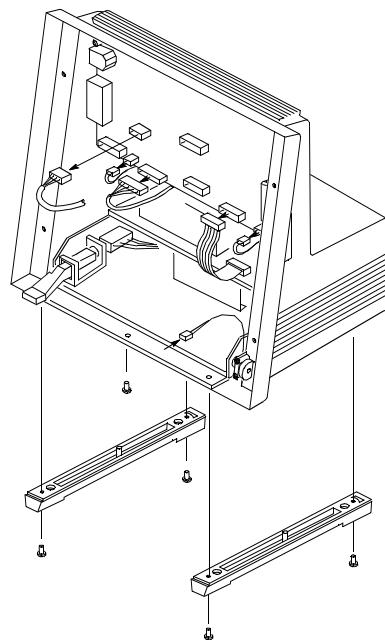
- On rear housings with a serial prefix <3608, secure the 5 screws and ground lug at the rear of the instrument as shown below.



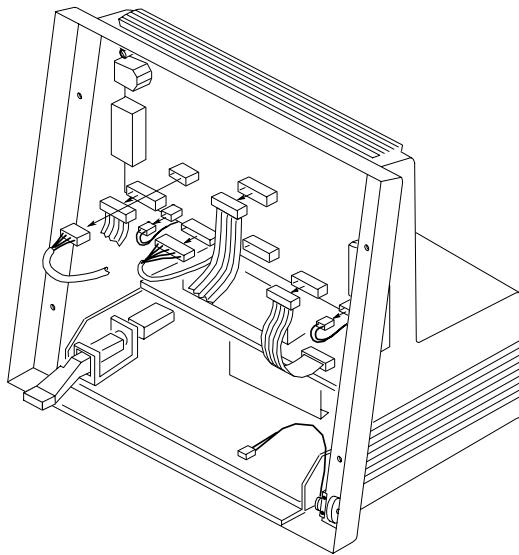
- On rear housings with a serial prefix code of  $\geq 3608$ , secure the 6 screws at the rear of the instrument.



- 6 From underneath the instrument, replace one retaining screw.
- 7 From underneath the instrument, replace the 4 screws securing the instrument feet to the Rear Housing.



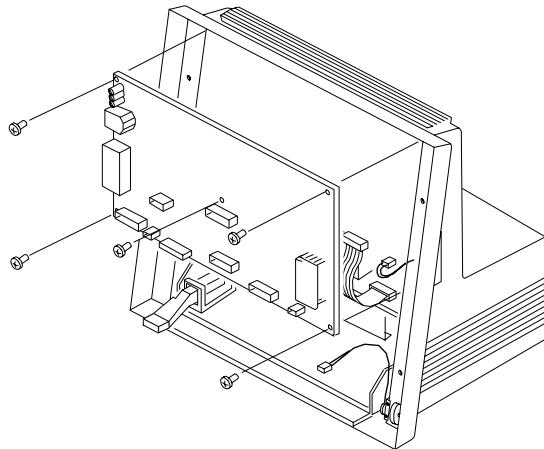
- 8 Connect all cables to the System Board as shown.



- 9 Install the Front Housing Assembly.

### **Replacing the System Board**

- 1 Insert the System Board into the Rear Housing.
- 2 Replace the 5 screws securing the System Board to the Rear Housing.

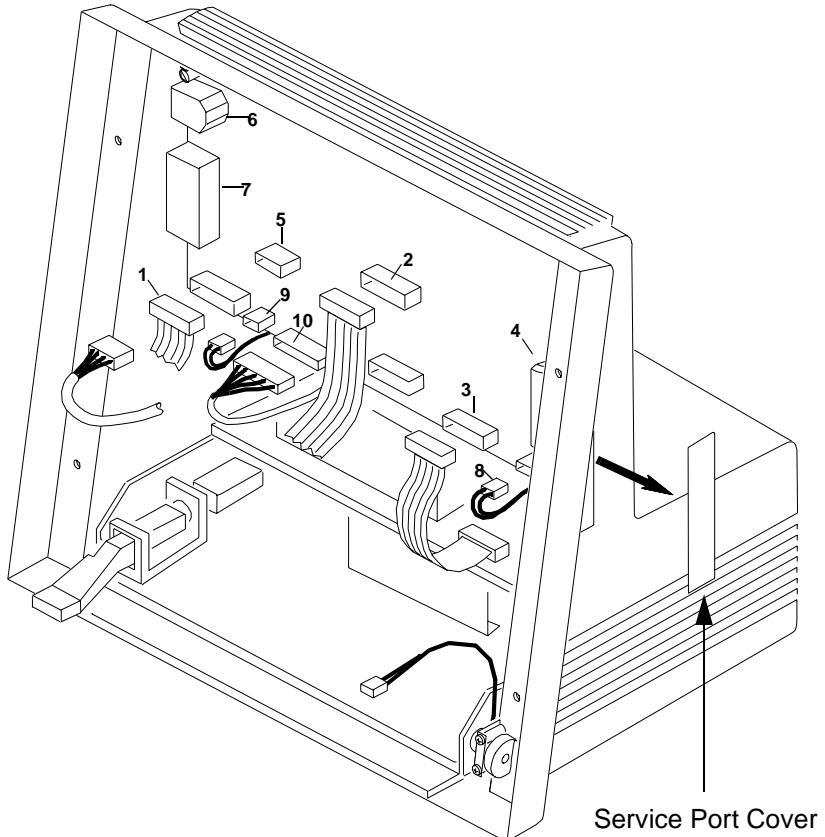


- 3 If the System Board was replaced, reprogram the Flash Memory. Refer to “Upgrade and Cloning Instructions” on page 2-31.
- 4 Insert the Service Port Cover into the Rear Housing.

**5** Connect the cables to the System Board as shown.

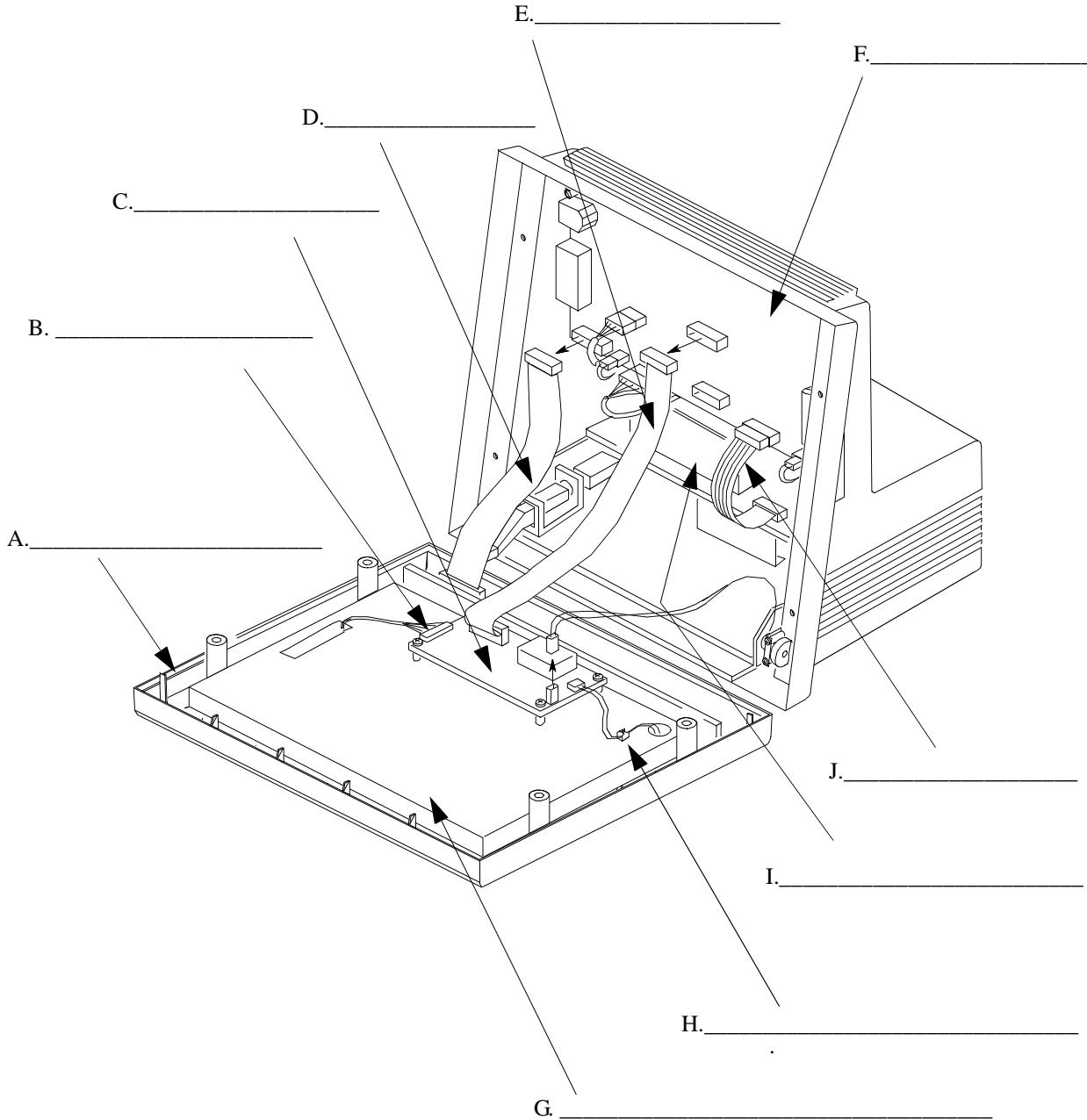
**System Board interface  
connectors:**

1. Keypad connector
2. Flat Panel Data Connector
3. 5V and 12V power supply connector
4. Service ports (not cabled)
5. SDN interface cable
6. Defib sync connector (not cabled)
7. Front-end link connector
8. Speaker connector
9. 60 VDC power supply connector
10. RS232 connector (with option J13)



## Practice Exercise

To check your understanding, please complete the following exercise. Write the name of each assembly in the space provided which correspond to each letter shown in the illustration. After naming each replaceable assembly, check your answer with the answers provided on the following page.



## **Practice Exercise Answers**

- A. Front Housing
- B. Flat Panel Interface Cable
- C. Flat Panel Adapter Board
- D. Keypad Cable
- E. Flat Panel Data Cable
- F. System Board
- G. Flat Panel Display Assembly (or Flat Panel Bracket containing the Flat Panel)
- H. Backlight Cable
- I. Power Supply Assembly
- J. 5v/12v Power Supply Cable



# Chapter 7 Repairing the Agilent Model V24C/V26C

## Objective

After reading this chapter and Chapter 9 *Front Housing Assembly V24C/V26C & V24CT/V26CT*, and completing the Practice Exercises, you will be able to **remove** and **replace** the following Agilent Model V24C/V26C major assemblies:

- Front Housing Assembly and major components (see Chapter 9)
- Rear Housing Assembly and major components

## In this chapter

The removal and replacement procedures for the instrument are easy to complete when following the step-by-step procedures. There are two parts to this chapter; namely, disassembly and reassembly. At the end of this chapter complete the practice exercise in to check your understanding of how to remove and replace the key field-replaceable assemblies.

Topics	See Page	Topics	See Page
<b><i>Front Housing Removal Procedures</i></b>		<b><i>Front Housing Replacement Procedures</i></b>	
Removing the Front Housing Assembly	9-2	Replacing the Front Housing Keypad	9-26
Removing the Board Shield	9-5	Replacing the Flat Panel Backlight	9-26
Removing the Flat Panel Display Assembly	9-14	Replacing the Flat Panel	9-28
Removing the 3-Board Assembly	9-14, 9-8	Replacing the 3-Board Assembly	9-29
Removing the Flat Panel	9-16, 9-10	Replacing the Flat Panel Display Assembly	9-31
Removing the Flat Panel Backlight Tube	9-17, 9-11	Replacing the Board Shield	9-34
Removing the Front Housing Keypad	9-12	Replacing the Front Housing Assembly	9-32
<b><i>Rear Housing Removal Procedures</i></b>		<b><i>Rear Housing Replacement Procedures</i></b>	
Removing the System Board	7-5	Replacing the Power Supply Assembly	7-13
Removing the Power Supply Assembly	7-8	Replacing the System Board	7-16
		<b><i>Practice Exercises</i></b>	7-19

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**NOTE**

Your Model V24C/V26C is one of five different versions:

Opt. 021 = Standard

Opt. 022 = MDD (Medical Device Directive)

Opt. 023 = Asian

Opt. 026 = New Display (MDD-compatible)

Opt. 027 = Asian, New Display (MDD-compatible)

Which one you have depends on the country to which it was shipped by the factory. You can differentiate them by looking at the “option string” on the serial number label on the right-hand side of the monitor.

The difference between MDD and Standard versions is increased shielding for the:

- Antiglare Screen
- Brightness Control Assembly
- Keypad Cable

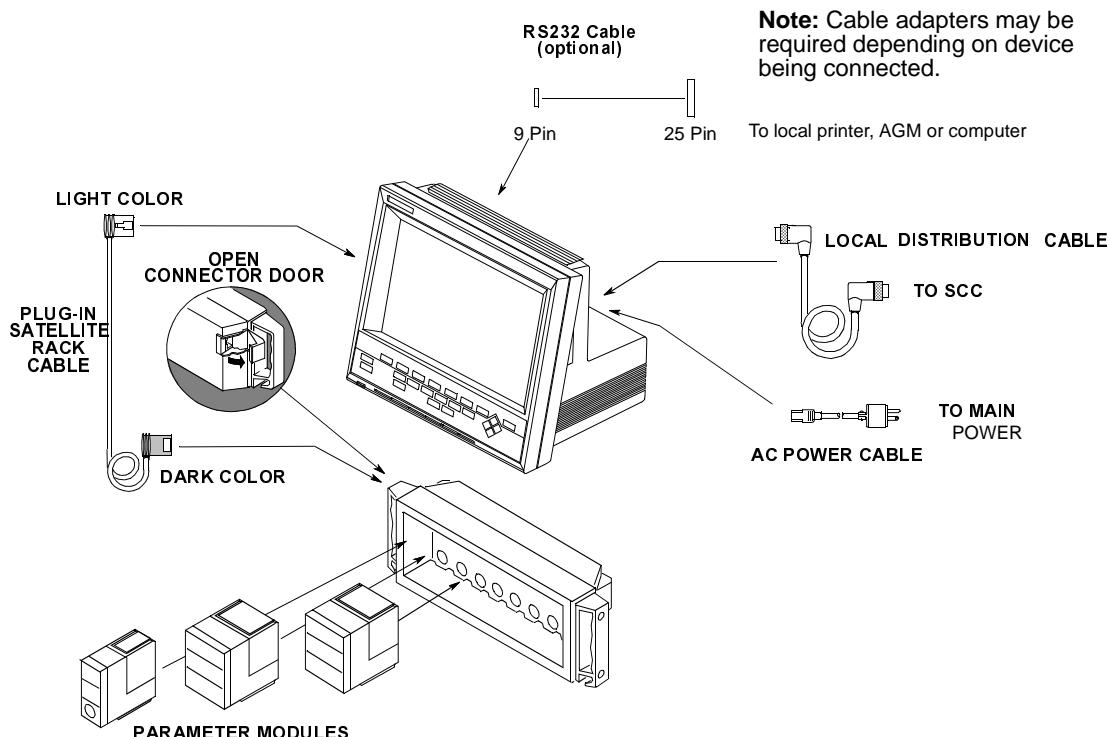
## Removal Procedures

This section presents procedures to disassemble the instrument to the extent required to remove and replace faulty assemblies. Do not further disassemble the product past the point described in these procedures.

### **WARNING**

**High Voltage - Voltages dangerous to life are present in the instrument. Do not perform any disassembly or reassembly procedures (other than parameter module removal) with power applied to the instrument. Failure to adhere to this warning could cause serious injury or death.**

Before doing any disassembly, turn power off and disconnect the Local Distribution Cable, AC power cable, Plug-in Satellite Rack cable, Defib sync cable, and RS232 Cable (where appropriate).



### Tools required

- 5mm hex nut driver
- 5.5mm hex nut driver
- small flat-bladed screwdriver
- small jeweler-sized Phillips screwdriver

- Pozidrive screwdriver (medium)

## Removing the Front Housing

See Chapter 9

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## Removing the Rear Housing

Disassembling the Rear Housing consists of two parts:

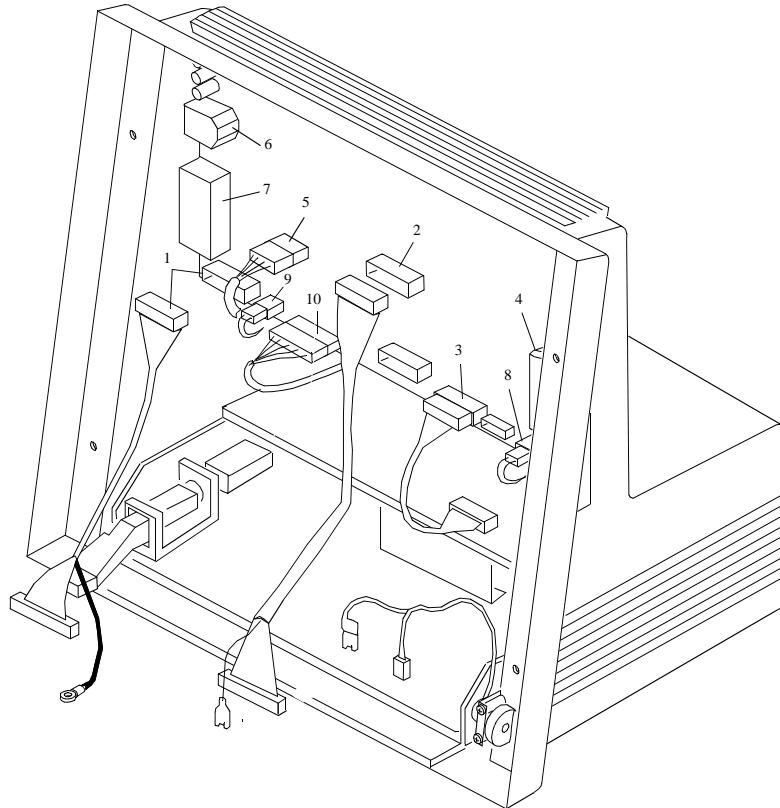
- 1 Removing the System Board
- 2 Removing the power supply

### **Removing the System Board**

- 1 Remove the Front Housing.
- 2 Disconnect the cables from the System Board as shown below.

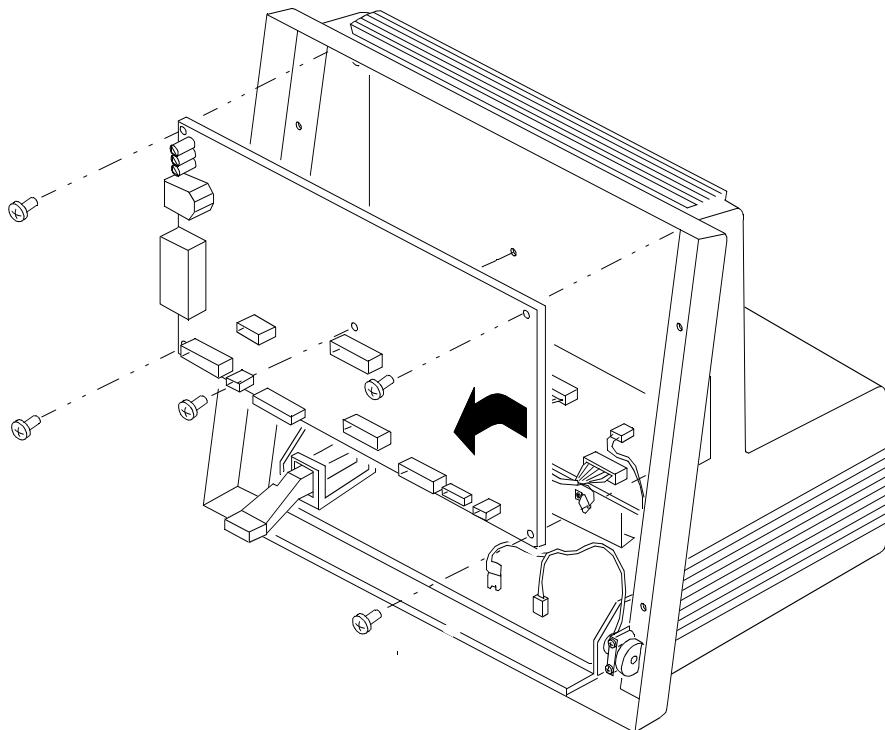
**System Board interface  
connectors:**

1. Keypad connector
2. Flat Panel Data Connector
3. 5V and 12V power supply connector
4. Service ports (not cabled)
5. SDN interface cable
6. Defib sync connector (not cabled)
7. Front-end link connector
8. Speaker connector
9. 60 VDC power supply connector
10. RS232 connector (with option J13)



**3** Using a small (1/8" inch) flat-blade screwdriver, pry the service port cover from the Rear Housing and remove.

- 4** Remove the 5 screws securing the System Board to the Rear Housing.



- 5** Remove the System Board from the Rear Housing.

## **Removing the Power Supply Assembly**

### **CAUTIONS**

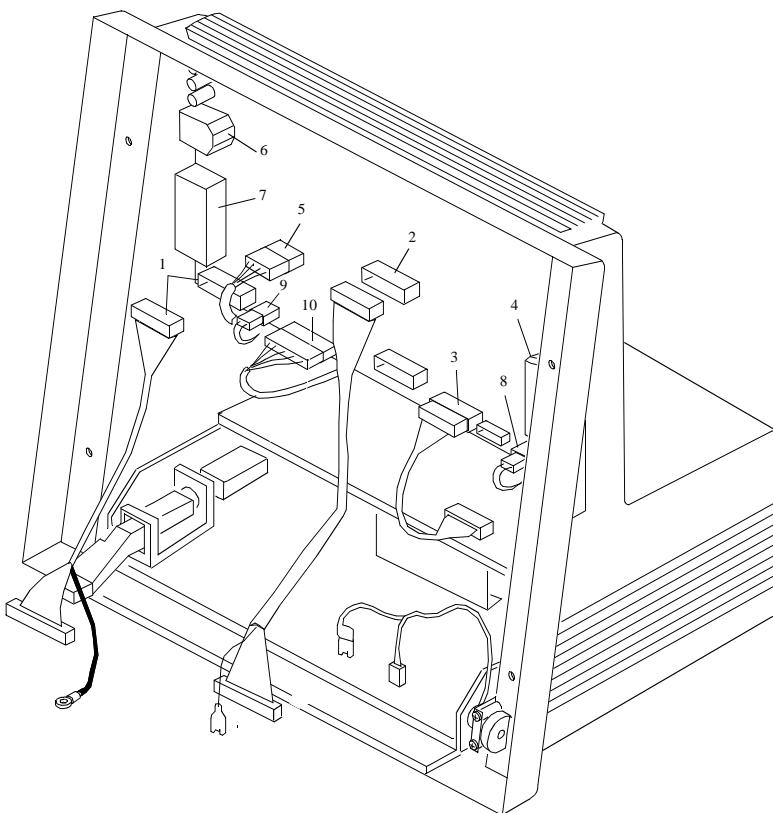
**A. Power leakage to ground may occur due to dirty cable connectors. The power supply cable connectors should be verified for cleanliness after removing and before replacing the power supply.**

**B. You should perform the leakage current test described in Chapter 2 whenever removing and replacing the power supply. A ground fault may occur causing a user safety concern.**

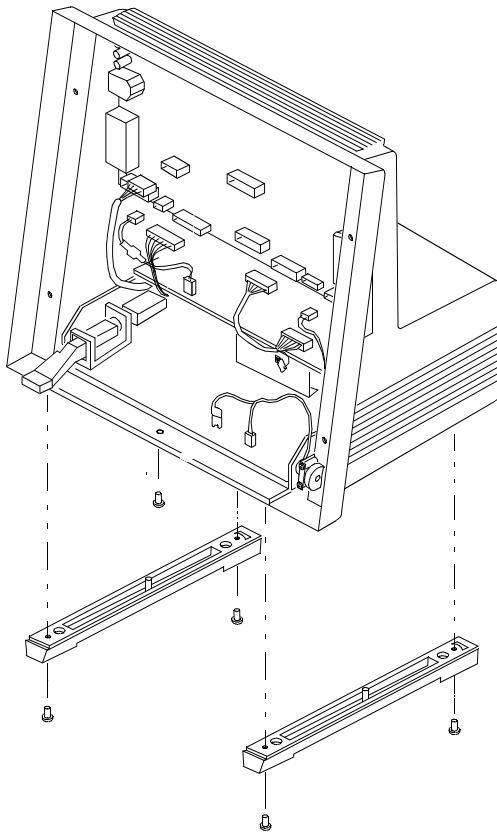
- 1 Turn power off to the instrument and disconnect the AC power cord.**
- 2 Remove the Front Housing Assembly (described earlier in this chapter).**
- 3 Disconnect all cables from the System Board as shown**

### **System Board interface connectors:**

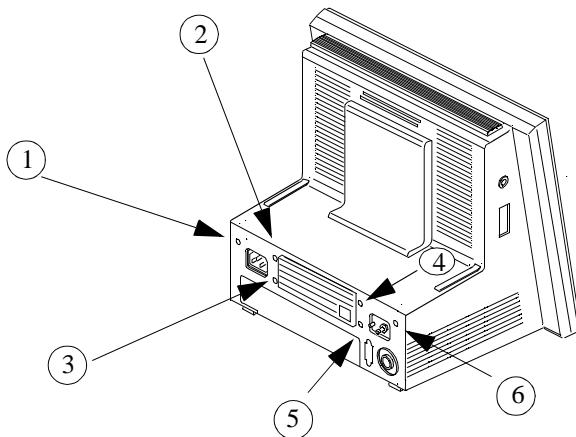
- 1 Keypad connector**
- 2 Flat Panel Data Connector**
- 3 5V and 12V power supply connector**
- 4 Service ports (not cabled)**
- 5 SDN interface cable**
- 6 Defib sync connector (not cabled)**
- 7 Front-end link connector**
- 8 Speaker connector**
- 9 60 VDC power supply connector**
- 10 RS232 connector (with option J13)**



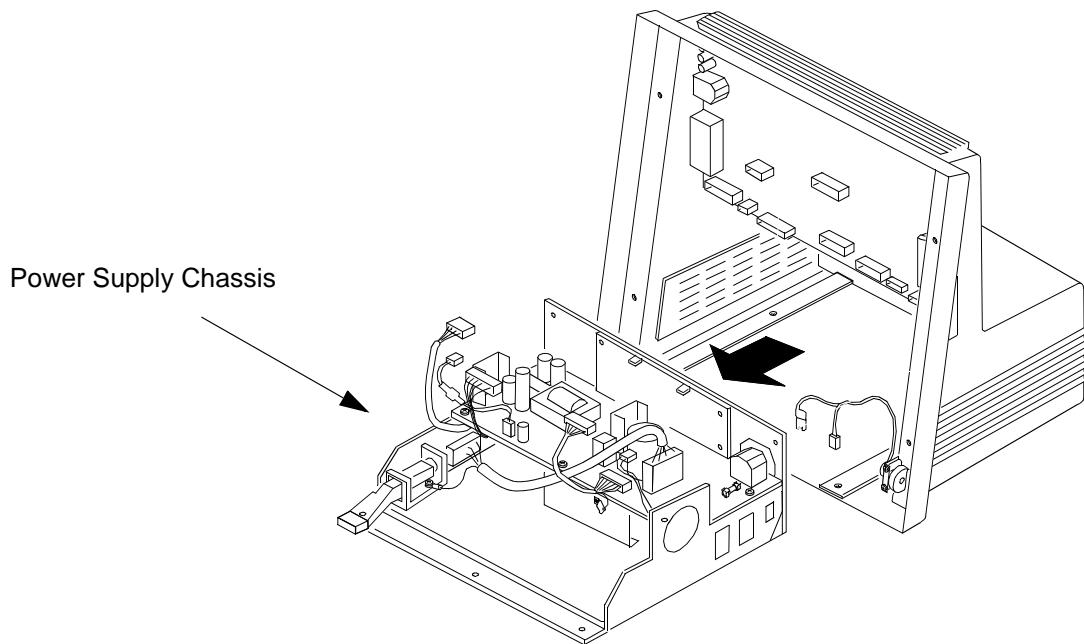
- 4 From underneath the instrument, remove 4 screws securing the instrument feet to the Rear Housing. Remove feet.



- 5 From underneath the instrument, remove one retaining screw at the front center of the Rear Housing.
- 6 Remove the 6 screws at the rear of the instrument.

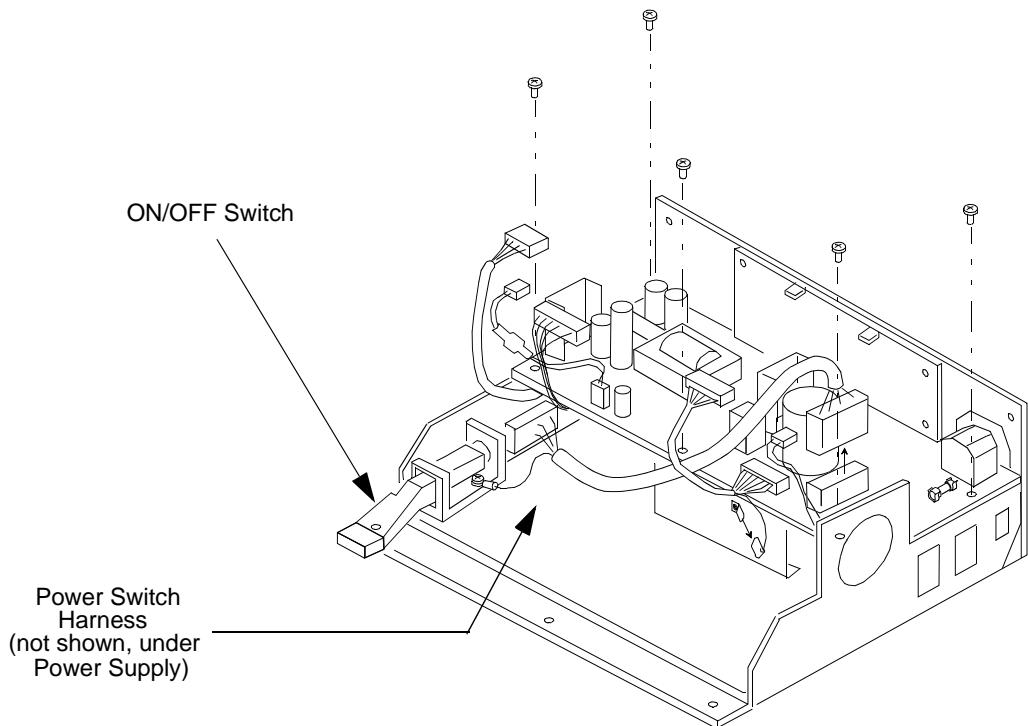


**7** Slide the Power Supply Chassis Assembly from the front of the Rear Housing



- 8** Disconnect the 5v/12v Power Supply cable ground lug from the chassis.
- 9** Disconnect the power switch cable from the Power Supply Board by pushing in the 2 tabs on the connector and pulling up.

**10** Remove 5 screws connecting the Power Supply Board to the chassis.



**11** Lift Power Supply Board off the chassis.

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**NOTE** If replacing the Power Supply Board, move the 5v/12v cable and 60v cable to the replacement Power Supply Board.

## Replacement Procedures

The procedures described in this section begin with the instrument's power turned off and the instrument disassembled.

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**WARNING**

High Voltage - Voltages dangerous to life are present in the instrument. Do not perform any assembly procedures (other than parameter module installation) with power applied to the instrument. Failure to adhere to this warning could cause serious injury or death.

## Rear Housing Replacement

Re-assembling the rear housing consists of two parts

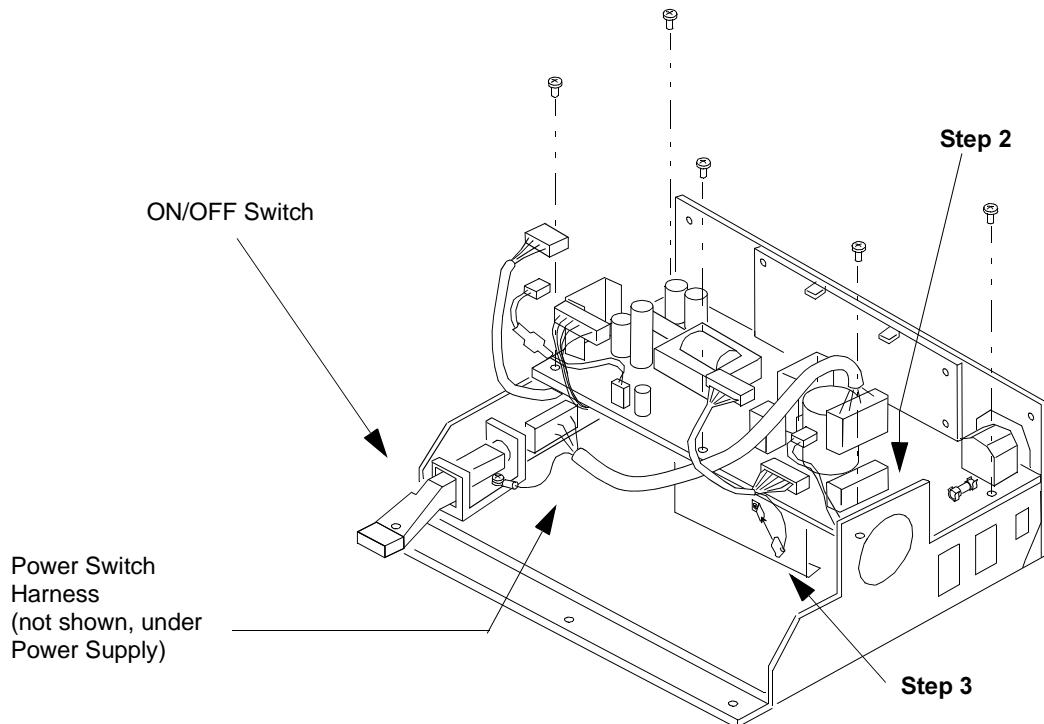
- 1 Installing the Power Supply
- 2 Installing the System Board

### Replacing the Power Supply Board

#### **CAUTIONS**

- A.** Power leakage to ground may occur due to dirty cable connectors. The power supply cable connectors should be verified for cleanliness after removing and before replacing the power supply.
- B.** You should perform the leakage current test described in Chapter 2 whenever removing and replacing the power supply. A ground fault may occur causing a user safety concern.

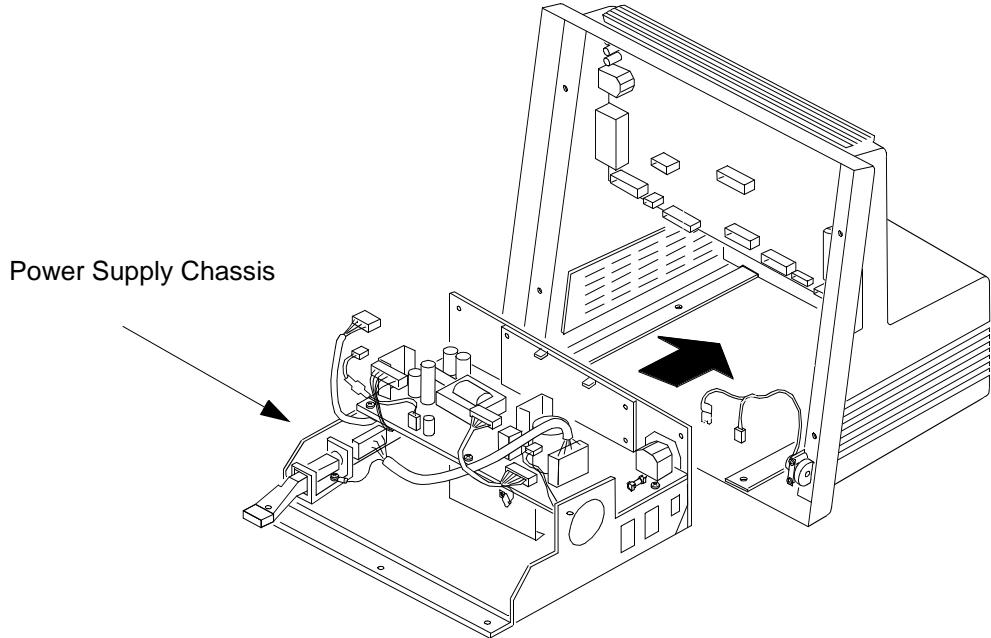
- 1 Screw in the 5 screws connecting the Power Supply Board to the chassis.



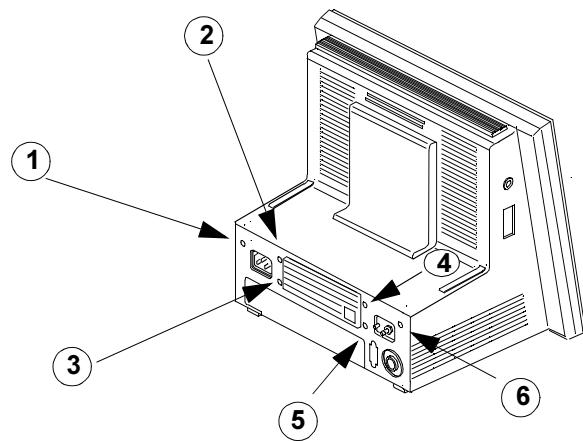
- 2 Push the power switch cable connector down onto the mating connector on the Power Supply Board.
- 3 Attach the 5v/12v Power Supply cable ground lug to the chassis.

**NOTE** If replacing the Power Supply Board, move the 5v/12v cable and 60v cable to the replacement Power Supply Board.

- 4 Slide the Power Supply Chassis Assembly into the Rear Housing.

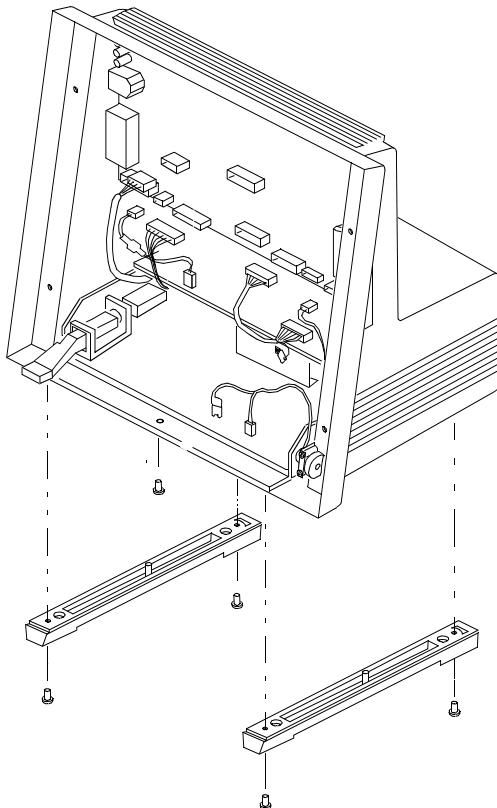


- 5 Secure the 6 screws at the rear of the instrument.



- 6 From underneath the instrument, replace one retaining screw at the front center of the Rear Housing.

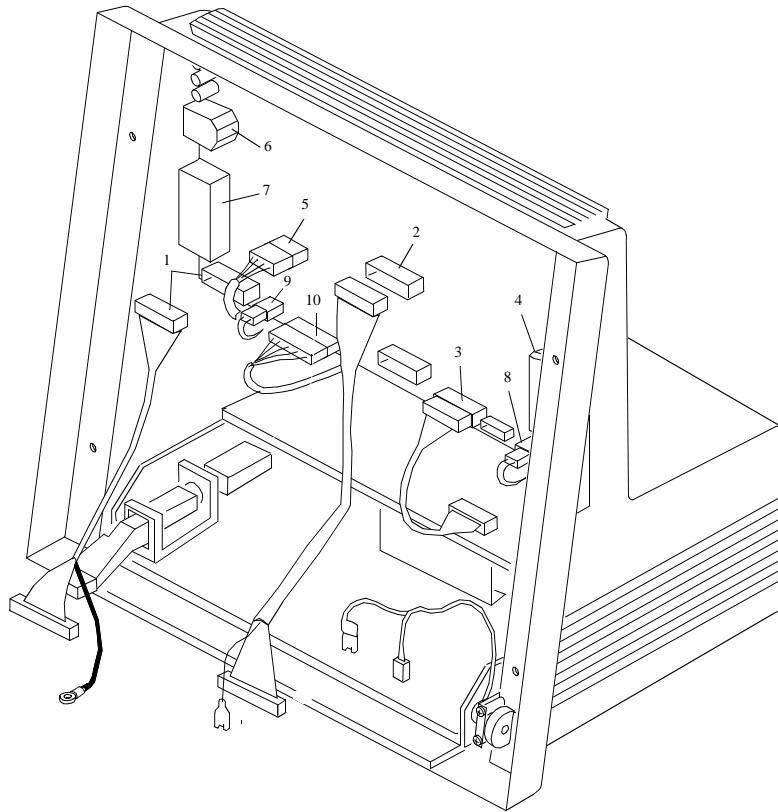
- 7 From underneath the instrument, replace the 4 screws securing the instrument feet to the Rear Housing.



- 8 If the System board is currently installed, connect all cables to the System Board as shown, otherwise proceed to the following section, *Replacing the System Board*.

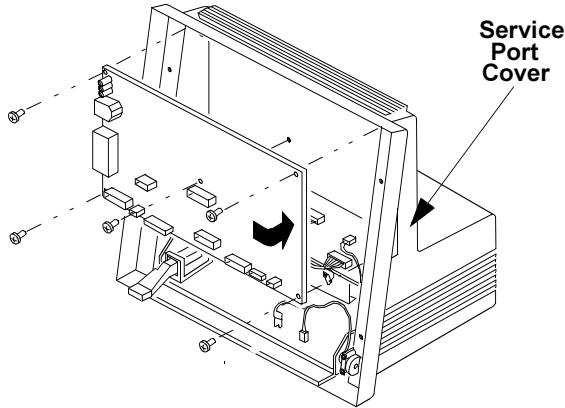
**System Board interface  
connectors:**

1. Keypad connector
2. Flat Panel Data Connector
3. 5V and 12V power supply connector
4. Service ports (not cabled)
5. SDN interface cable
6. Defib sync connector (not cabled)
7. Front-end link connector
8. Speaker connector
9. 60 VDC power supply connector
10. RS232 connector (with option J13)



### Replacing the System Board

- 1 Insert the System Board into the Rear Housing.
- 2 Replace the 5 screws securing the System Board to the Rear Housing.



- 3 If the System Board was replaced, reprogram the Flash Memory. Refer to “Upgrade and Cloning Instructions” on page 2-31.
- 4 Insert the service port cover into the Rear Housing.
- 5 Connect the cables from the System Board System Board as shown at the top of the page.
- 6 Reinstall the Front Housing Assembly.

# Chapter 8 Repairing the Agilent Model V24CT/V26CT

## Objective

After reading this chapter and Chapter 9 *Front Housing Assembly V24C/V26C & V24CT/V26CT*, and completing the Practice Exercises, you will be able to **remove** and **replace** the following Agilent Model V24CT/V26CT major assemblies:

- Front Housing Assembly and major components (see Chapter 9)
- Rear Housing Assembly and major components

## In this chapter

The removal and replacement procedures for the instrument are easy to complete when following the step-by-step procedures. There are two parts to this chapter; namely, disassembly and reassembly. At the end of this chapter complete the practice exercise in to check your understanding of how to remove and replace the key field-replaceable assemblies.

Topics	See Page	Topics	See Page
<b><i>Front Housing Removal Procedures</i></b>		<b><i>Rear Housing Replacement Procedure</i></b>	
Removing Lead Acid Batteries	8-5	Replacing Parameter Module Rack Connector	8-15
Removing the Front Housing Assembly	9-2	Replacing Power Supply Assembly	8-15
Removing the Board Shield	9-5, 9-13	Replacing System Board	8-17
Removing the Flat Panel Display Assembly	9-6, 9-14	Replacing Battery Contact Board	8-18
Removing the 3-Board Assembly	9-8, 9-14	<b><i>Front Housing Replacement Procedures</i></b>	
Removing the Flat Panel	9-10, 9-16	Replacing Front Housing Keypad	9-26
Removing the Flat Panel Backlight Tube	9-11, 9-17	Replacing the Flat Panel Backlight	9-26
Removing the Front Housing Keypad	9-12	Replacing the Flat Panel	9-28
<b><i>Rear Housing Removal Procedures</i></b>		Replacing the 3-Board Assembly	9-29
Removing the Battery Contact Board	8-7	Replacing the Flat Panel Display Assembly	9-31
Removing the System Board	8-8	Replacing the Board Shield	9-34
Removing the Power Supply Assembly	8-10	Replacing the Front Housing Assembly	9-32
Removing the Parameter Module Rack Connector	8-13	Replacing Parameter Rack Assembly	9-34
		Replacing Lead Acid Batteries	8-18
		<b><i>Practice Exercises</i></b>	8-19

*Agilent M1205A V24/V26 Series Service Guide*

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**NOTE**

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Your Model V24CT/V26CT is one of four different versions:  
Opt. 024 = Standard  
Opt. 025 = Asian  
Opt. 028 = Asian, New Display  
Opt. 029 = Standard, New Display

Which one you have depends on the country to which it was shipped by the factory. You can differentiate them by looking at the “option string” on the serial number label on the right-hand side of the monitor.

The differences between Standard and Asian versions are the DSPC board and the language used on the keypad.

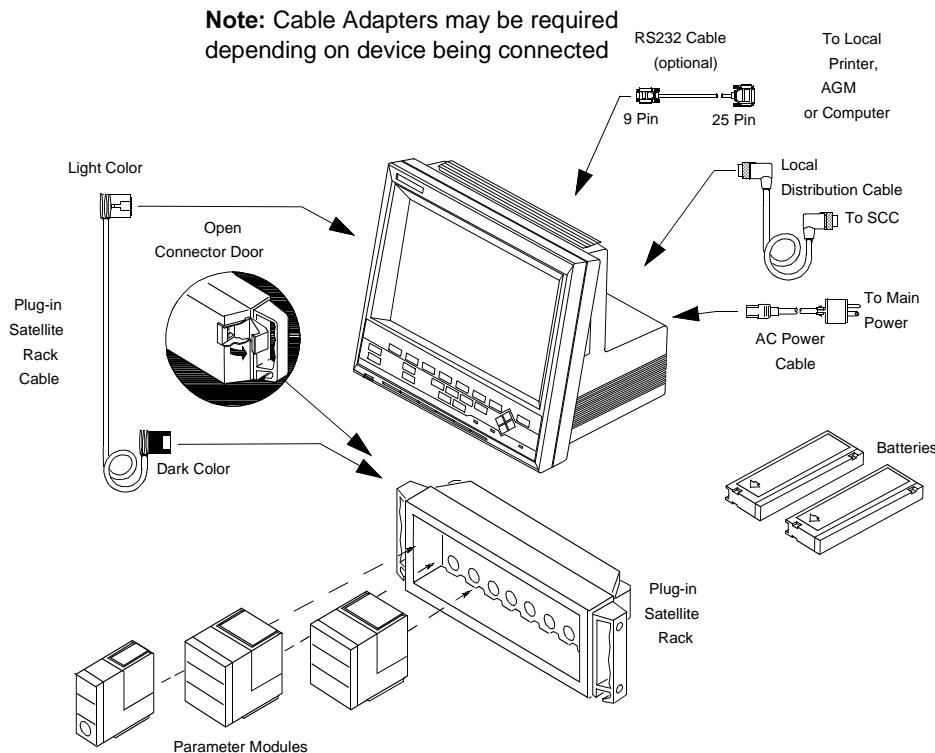
## Overview Removal Procedures

This section presents procedures to disassemble the instrument to the extent required to remove and replace faulty assemblies. Do not further disassemble the product past the point described in these procedures.

### **WARNING**

**High Voltage - Voltages dangerous to life are present in the instrument. Do not perform any disassembly or reassembly procedures (other than parameter module removal) with power applied to the instrument. Failure to adhere to this warning could cause serious injury or death.**

Before doing any disassembly, turn power off and disconnect the Local Distribution Cable, AC power cable, Plug-in Satellite Rack cable, Defib sync cable, and RS232 Cable (where appropriate), and remove batteries.



### Tools required

- 5mm hex nut driver
- 5.5mm hex nut driver
- small flat-bladed screwdriver
- small jeweler-sized Phillips screwdriver
- Pozidrive screwdriver (medium)

## Front Housing Removal Procedures

The procedures below processes are listed in the order they would occur should the front housings require complete disassembly.

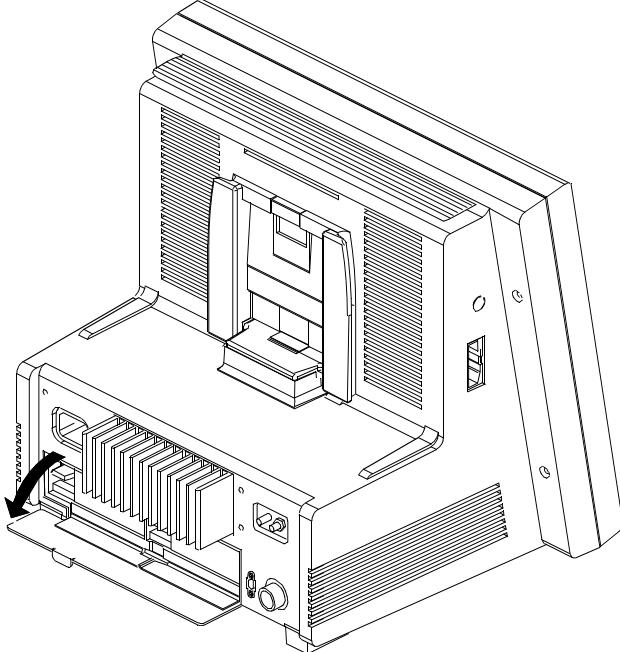
Should complete disassembly not be necessary, follow the procedures below only to the point required to remove and replace faulty assemblies.

Front housing removal consists of the following procedures:

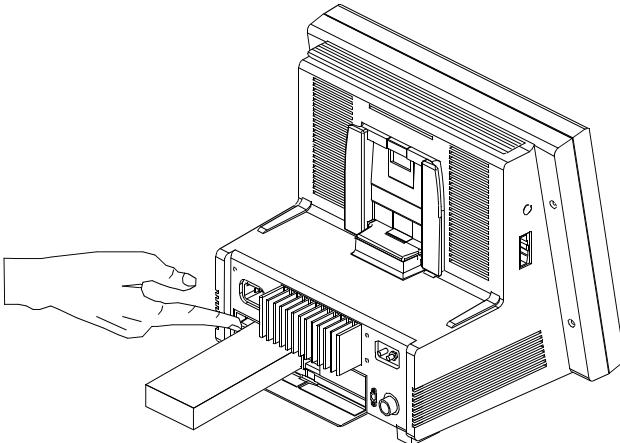
- 1** Removing power to the Model V24CT/V26CT by pressing the power switch to OFF and disconnecting the AC power cord.
- 2** Removing Lead Acid Batteries. See page 8-5.
- 3** Removing the Parameter Module Rack. See page 8-6.
- 4** Removing Front Housing Assembly. See page 9-2.
- 5** Removing Flat Panel Display Assembly. See page 9-14.
- 6** Removing the 3-Board Assembly. See page 9-14.
- 7** Removing Backlight Fluorescent Tube(s). See page 9-17.
- 8** Removing Front Housing Keypad. See page 9-12.

## Removing the Lead Acid Batteries

- 1 Remove power to the Model V24CT/V26CT by pressing the power switch to OFF and disconnecting the AC power cord.
- 2 At the rear of the Model V24CT/V26CT, open the battery door (swings downward).



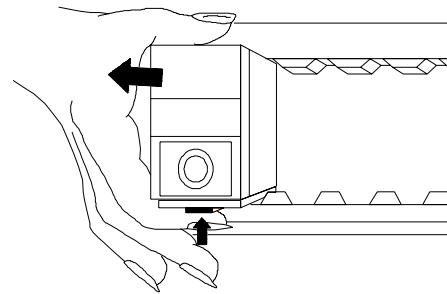
- 3 Lift up on the battery retaining switch and the battery pops out.



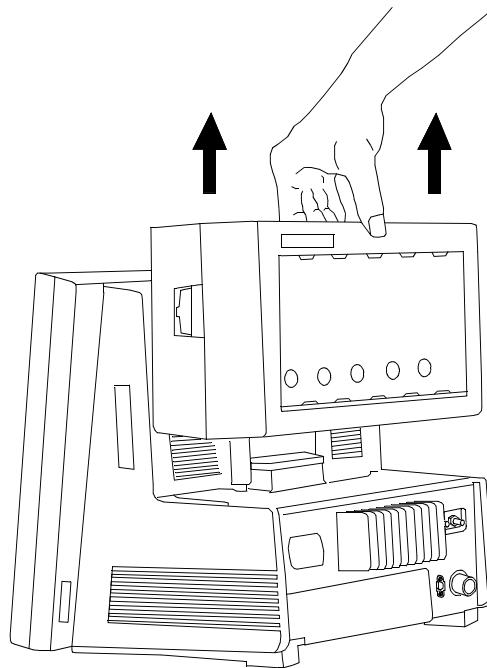
- 4 Repeat procedure for the second battery if necessary.

## Removing the Parameter Module Rack

- 1 Press the power switch to OFF and disconnect the AC power cord.
- 2 Remove Lead Acid batteries.
- 3 Remove parameter modules from parameter module rack by pressing up on retaining tab and sliding parameter modules from rack.



- 4 If you have a 6-slot rack docked to the V24CT/V26CT, press and hold retaining clip forward. Use other hand to hold monitor steady. Pull the parameter module rack from the monitor.



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## Front Housing Removal Procedures

For the rest of the front housing removal procedures see Chapter 9.

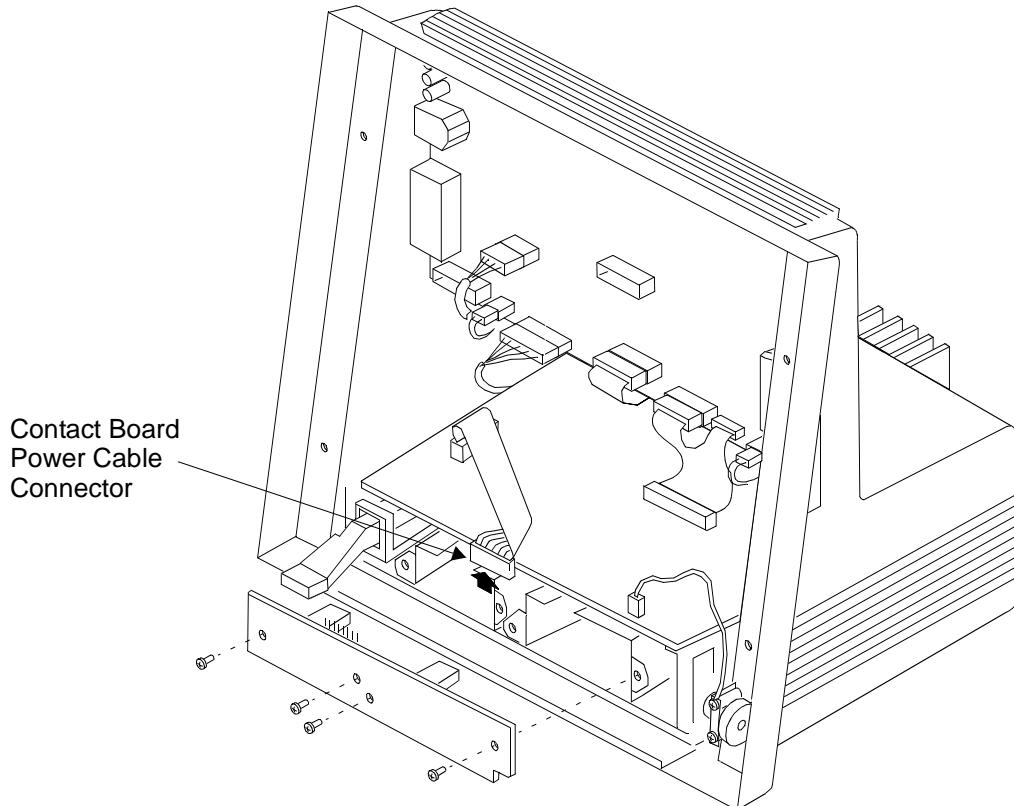
## Rear Housing Removal Procedures

Disassembling the Rear Housing consists of:

- 1 Removing power to the Model V24CT/V26CT by pressing the power switch to OFF and disconnecting the AC power cord.
- 2 Removing Lead Acid Batteries (see 9-5).
- 3 Removing Parameter Module Rack (see 9-6).
- 4 Removing the Front Housing Assembly (see 9-2).
- 5 Removing Battery Contact Board (see 9-7).
- 6 Removing the System Board (see 9-8).
- 7 Removing Power Supply Assembly (see 9-10).
- 8 Removing Parameter Module Rack Connector (see 9-13).

### Removing Battery Contact Board

- 1 Remove power to the Model V24CT/V26CT by pressing the power switch to OFF and disconnecting the AC power cord.
- 2 Remove batteries. See 9-5.
- 3 Remove Front Housing Assembly. See 9-2.
- 4 Remove battery contact board power cable connector.
- 5 Remove four screws securing battery contact board to power supply assembly
- 6 Remove battery contact board.

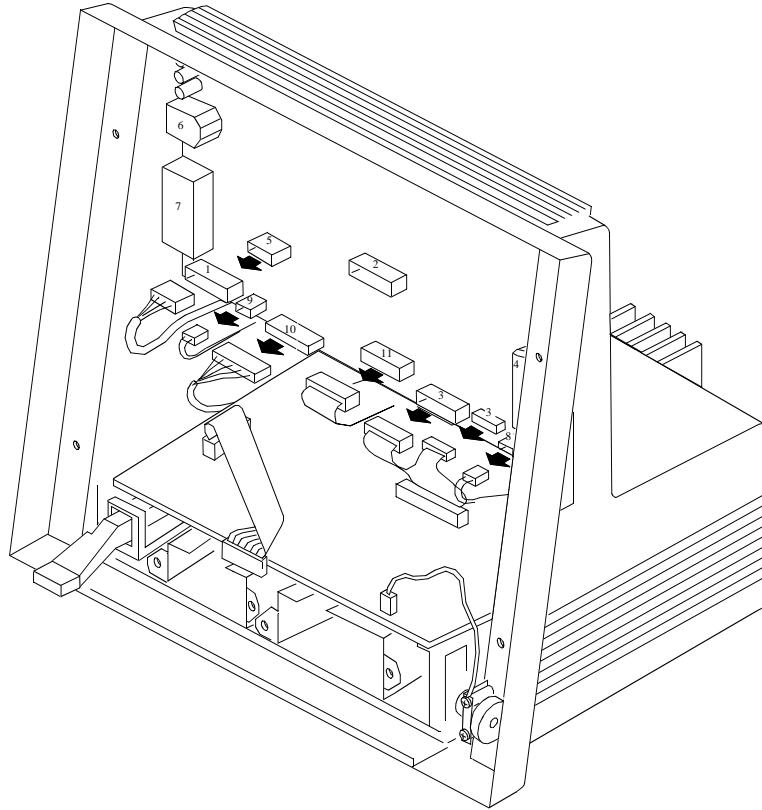


## Removing the System Board

- 1 Remove the Front Housing. See 9-2.
- 2 Disconnect the cables from the System Board as shown below.

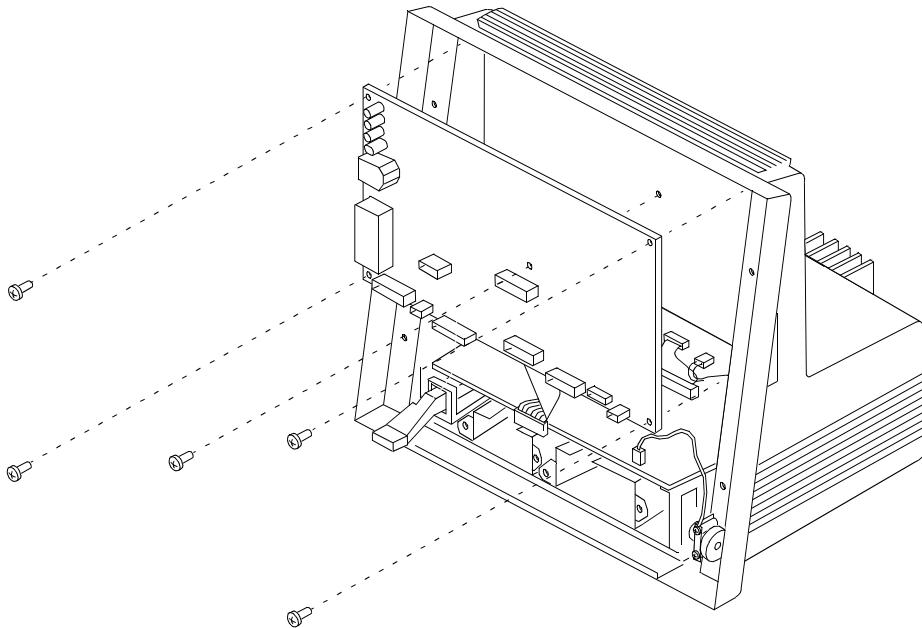
### System Board interface connectors:

1. Keypad connector
2. Flat Panel Data Connector
3. 5V and 12V power supply connector
4. Service ports (not cabled)
5. SDN interface cable
6. Defib sync connector (not cabled)
7. Front-end link connector
8. Speaker connector
9. 60 VDC power supply connector
10. RS232 connector (with option J13)
11. Docking Connector Cable



- 3 Using a small (1/8" inch) flat-blade screwdriver, pry the service port cover from the Rear Housing and remove.

- 4 Remove the 5 screws securing the System Board to the Rear Housing.



- 5 Remove the System Board from the Rear Housing.

## Removing the Power Supply Assembly

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### CAUTIONS

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**A.** Power leakage to ground may occur due to dirty cable connectors. The power supply cable connectors should be verified for cleanliness after removing and before replacing the power supply.

**B.** You should perform the leakage current test described in Chapter 2 whenever removing and replacing the power supply. A ground fault may occur causing a user safety concern.

**1** Turn power off to the instrument and disconnect the AC power cord.

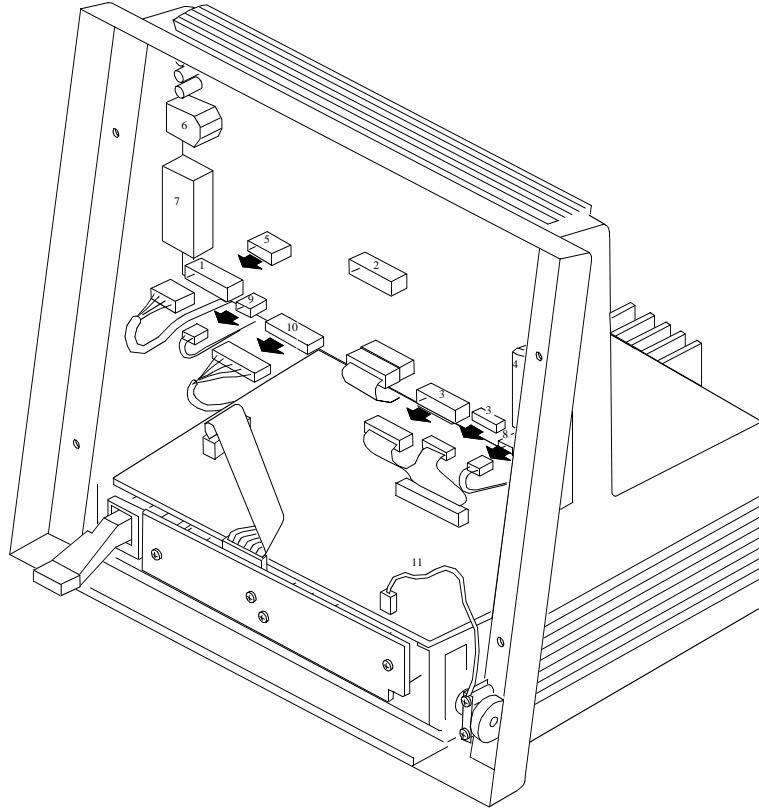
**2** Remove Lead Acid Batteries (see 9-5)

**3** Remove the Front Housing Assembly (see 9-2).

**4** Disconnect all cables from the System Board as shown

**System Board interface  
connectors:**

1. Keypad connector
2. Flat Panel Data Connector
3. 5V and 12V power supply connector
4. Service ports (not cabled)
5. SDN interface cable
6. Defib sync connector (not cabled)
7. Front-end link connector
8. Speaker connector
9. 60 VDC power supply connector
10. RS232 connector (with option J13)
11. Contrast Adjust Cable



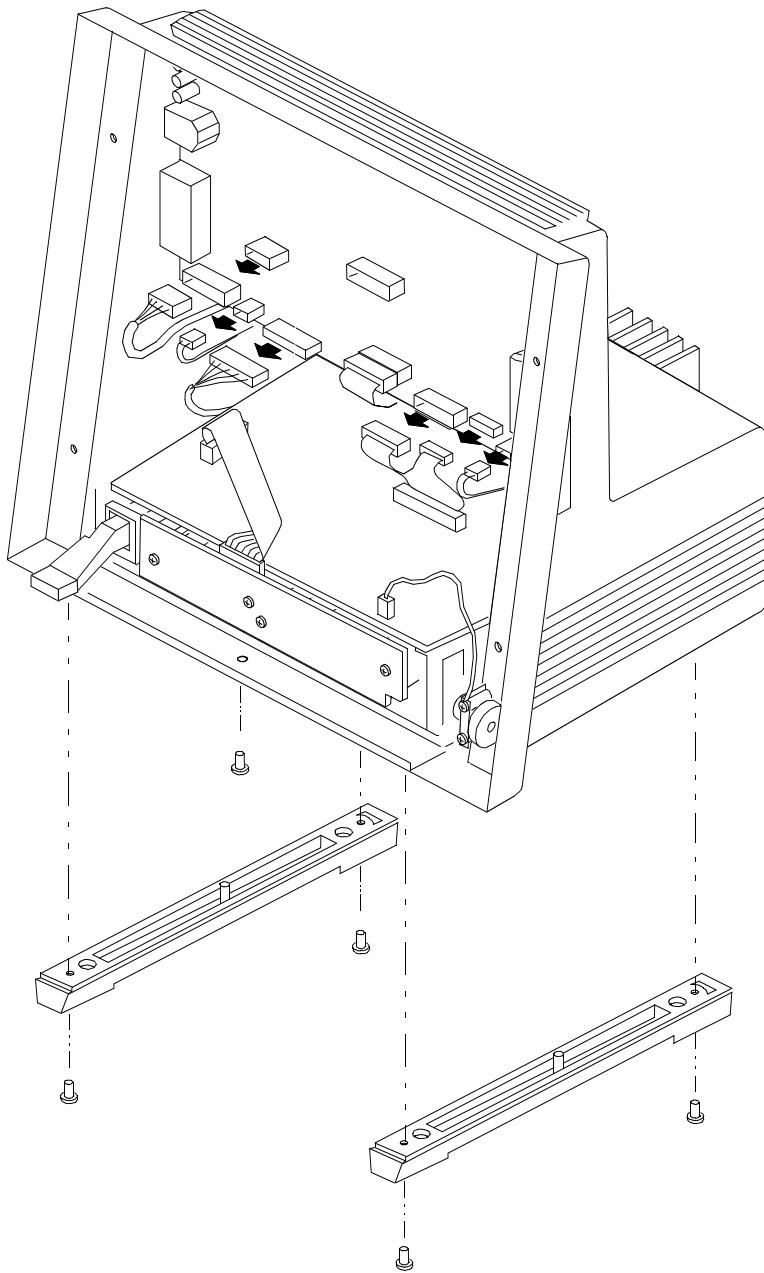
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### Note

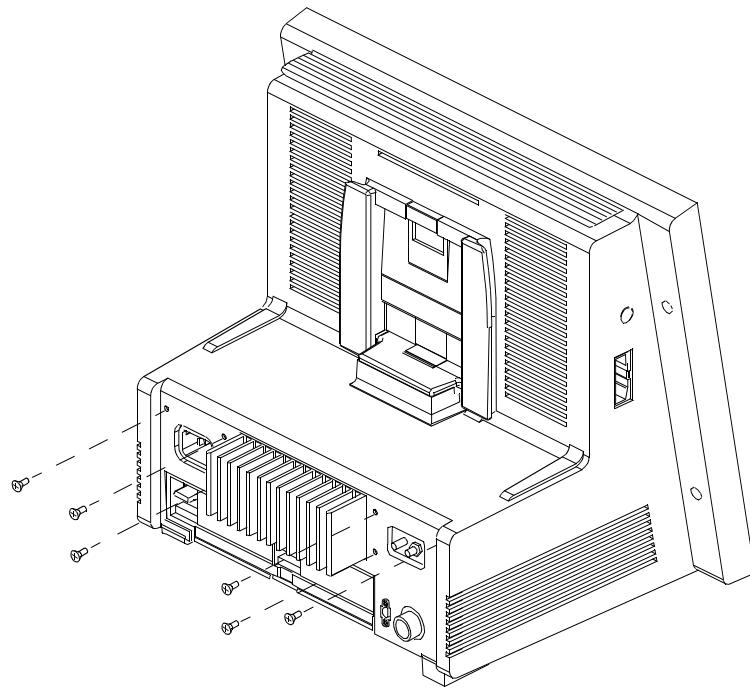
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If your power supply assembly is defective and your unit contains option J13, you need to remove the RS232 cable and install it in the replacement assembly using the same cable routing path. See "Replacing Power Supply Assembly" on page 9-15.

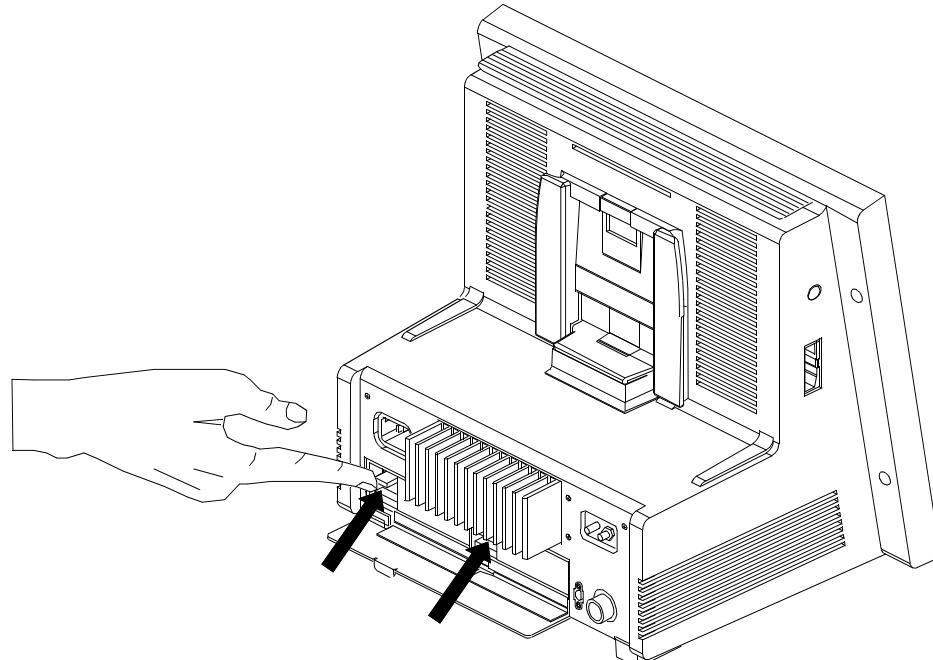
- 5 From underneath the instrument, remove 4 screws securing the instrument feet to the Rear Housing and 1 retaining screw. Remove feet.



- 6 At the rear of the instrument, remove six screws and ground lug securing assembly to rear of the rear housing.



- 7 Lift on the battery release levers so power supply assembly comes free from the rear housing.



- 8 Slide Power Supply assembly from front of rear housing.

## Removing Parameter Module Rack Docking Connector

- 1 Remove power to the Model V24CT/V26CT by pressing the power switch to OFF and disconnecting the AC power cord.
- 2 Remove Lead Acid Batteries (see 9-5).
- 3 Remove Front Housing Assembly (see 9-2).
- 4 Remove Power Supply Assembly (see 9-10).

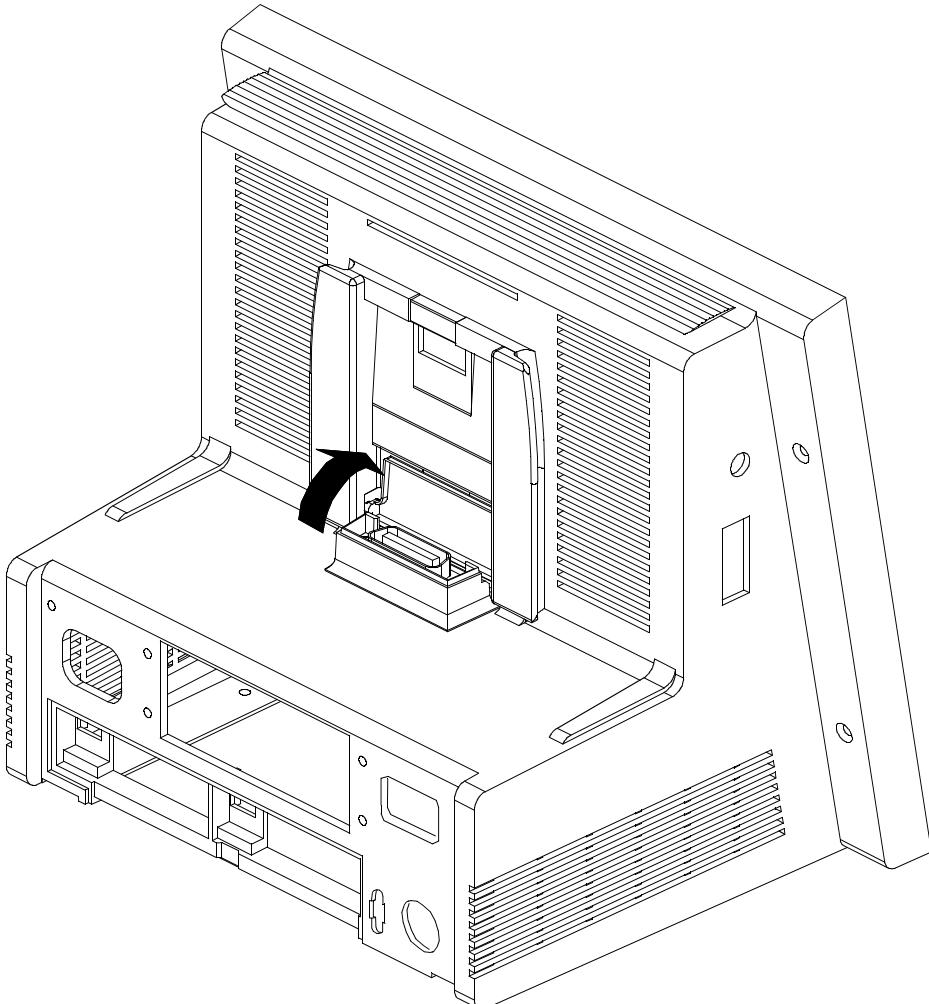
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**NOTE**

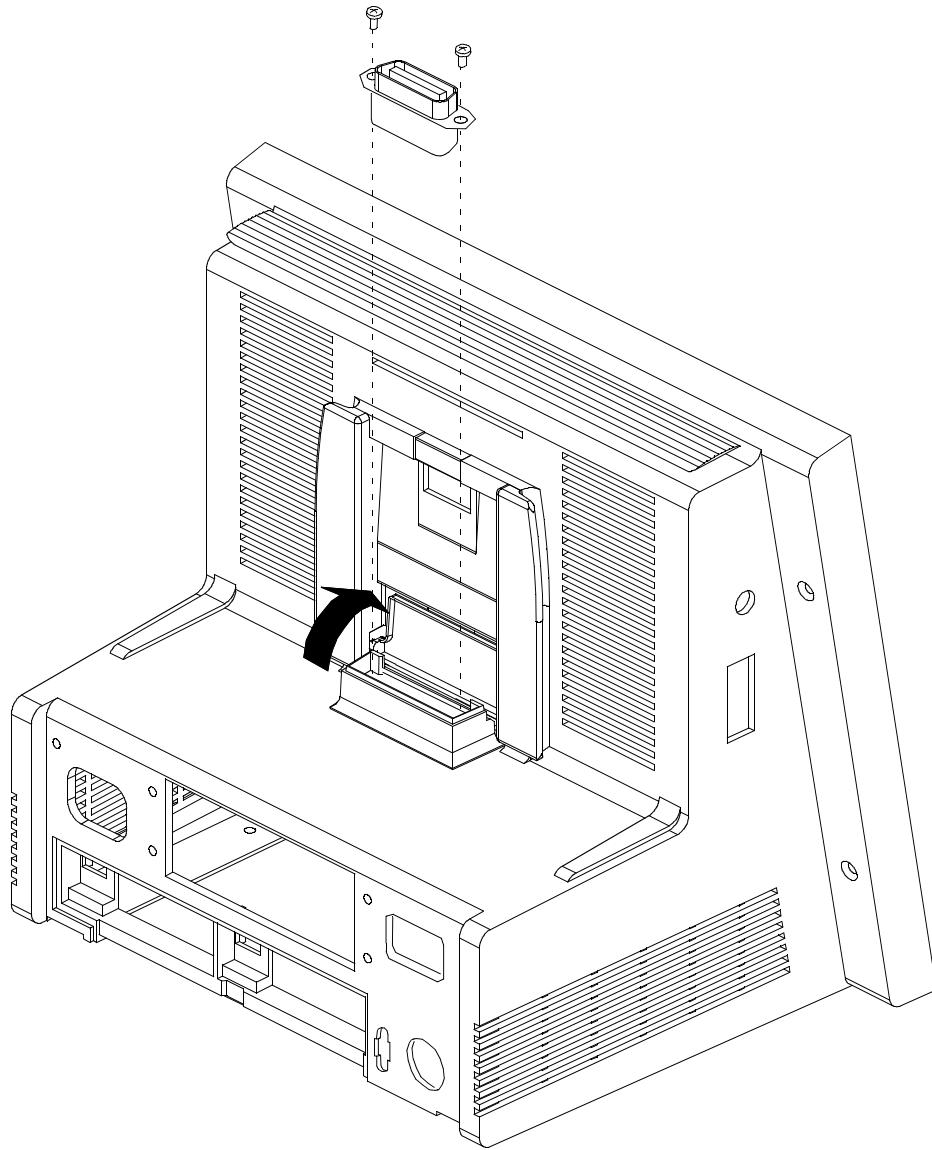
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You must complete the above steps to avoid risk of injury or damage to the instrument.

- 5 Open docking rack connector door.



- 6 Remove two screws and remove rack connector.



## Rear Housing Replacement Procedures

The procedures described in this section begin with the instrument's power turned off and the instrument disassembled.

---

**WARNING**

**High Voltage - Voltages dangerous to life are present in the instrument. Do not perform any assembly procedures (other than parameter module installation) with power applied to the instrument. Failure to adhere to this warning could cause serious injury or death.**

Replacing the rear housing consists of the following processes:

- 1 Verify power to the Model V24CT/V26CT is OFF and that the AC power cord is disconnected.
- 2 Verify that the Lead-Acid batteries have been removed. See 9-5.
- 3 Replace Parameter Module Rack Connector. See 9-15.
- 4 Replace Power Supply Assembly. See 9-15.
- 5 Replace System Board. See 9-17.
- 6 Replace Battery Contact Board. See 9-18.
- 7 Replace Front Housing. See 9-32.
- 8 Replace Parameter Module Rack. See 9-34.
- 9 Replace Lead-Acid batteries. See 9-18.

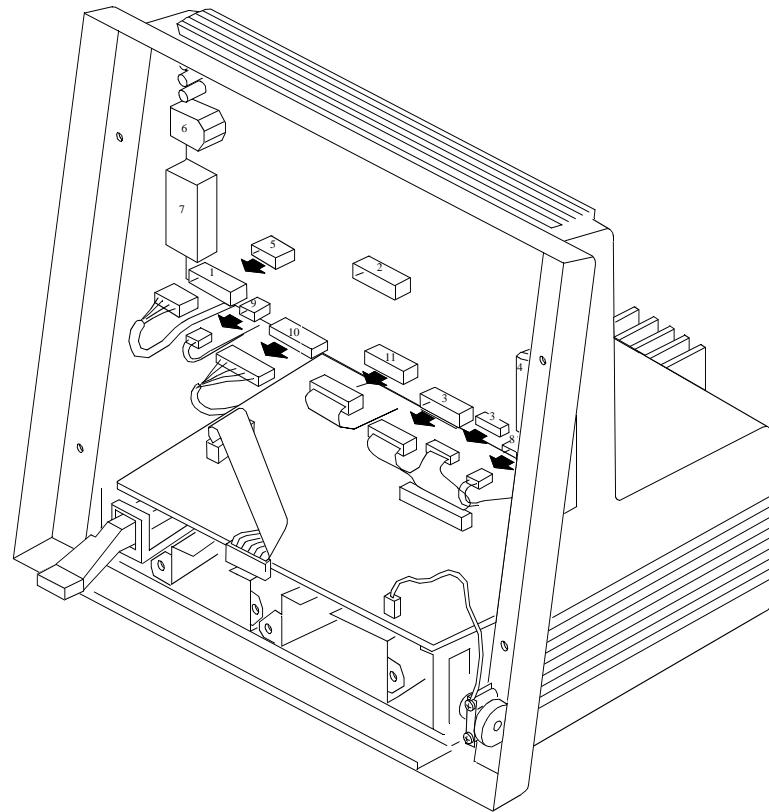
### Replacing Parameter Module Rack Connector

- 1 Verify power to the Model V24CT/V26CT is OFF and that the AC power cord is disconnected.
- 2 Verify that the Lead-Acid batteries have been removed.
- 3 Open rack connector door
- 4 Secure front end rack connector to rear housing using two screws.

### Replacing Power Supply Assembly

- 1 Verify power to the Model V24CT/V26CT is OFF and that the AC power cord is disconnected.
- 2 Verify that the Lead-Acid batteries have been removed.
- 3 If your unit has option J13, remove the RS232 cable from the defective assembly and install the RS232 cable into the new assembly following the same cable routing path.
- 4 Slide power supply assembly into front of rear housing.
- 5 At rear of the instrument, secure power supply assembly to rear of rear housing using six screws.
- 6 From underneath the instrument, install one retaining screw.
- 7 From underneath the instrument, secure feet to rear housing using four screws.
- 8 Connect system PCB\power supply interface cable to power supply assembly.
- 9 Connect all cables to Power Supply assembly. See illustration below.

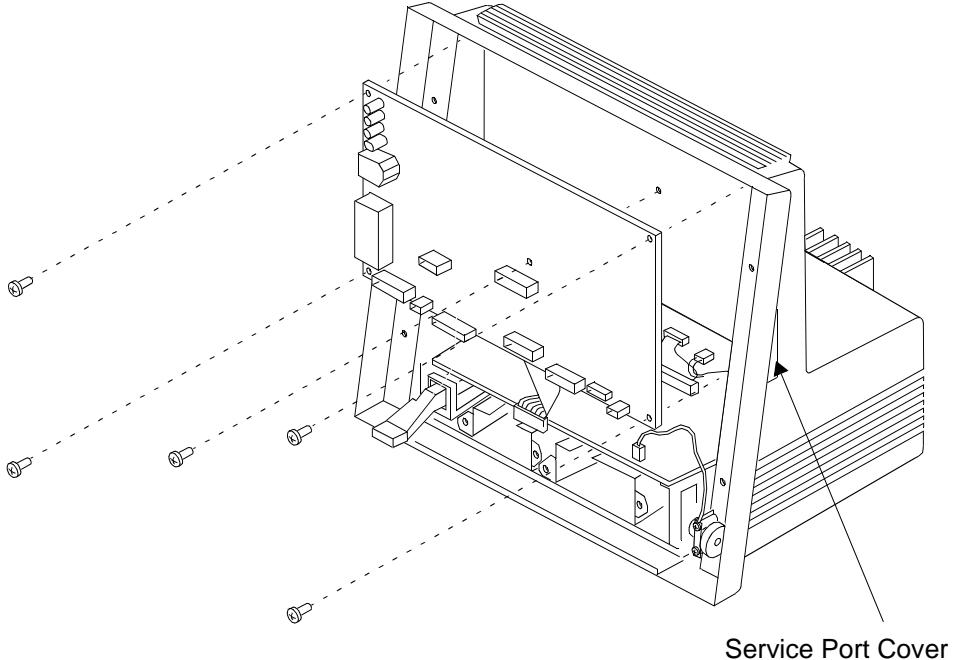
- 10** Connect contrast adjust, key board, and flat panel cables to Power Supply assembly.



- 11** Replace display assembly.  
**12** Replace lead-acid batteries.

## Replacing System Board

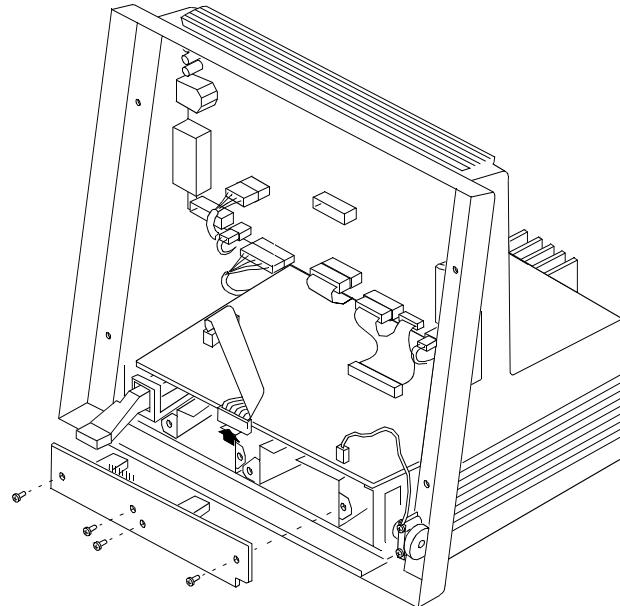
- 1 Verify power to the Model V24CT/V26CT is OFF and that the AC power cord is disconnected.
- 2 Verify that the Lead-Acid batteries have been removed.
- 3 Insert the System Board into the Rear Housing.
- 4 Replace the 5 screws securing the System Board to the Rear Housing.



- 5 If the System Board was replaced, reprogram the Flash Memory. Refer to *Upgrade and Cloning Instructions* in Chapter 2.
- 6 Insert the service port cover into the Rear Housing.
- 7 Connect the cables from the System Board.
- 8 Reinstall the Front Housing Assembly.

## Replacing Battery Contact Board

- 1 Verify power to the Model V24CT/V26CT is OFF and that the AC power cord is disconnected.
- 2 Verify that the Lead-Acid batteries have been removed.
- 3 Secure Battery Contact Board to Power Supply Assembly using four screws.



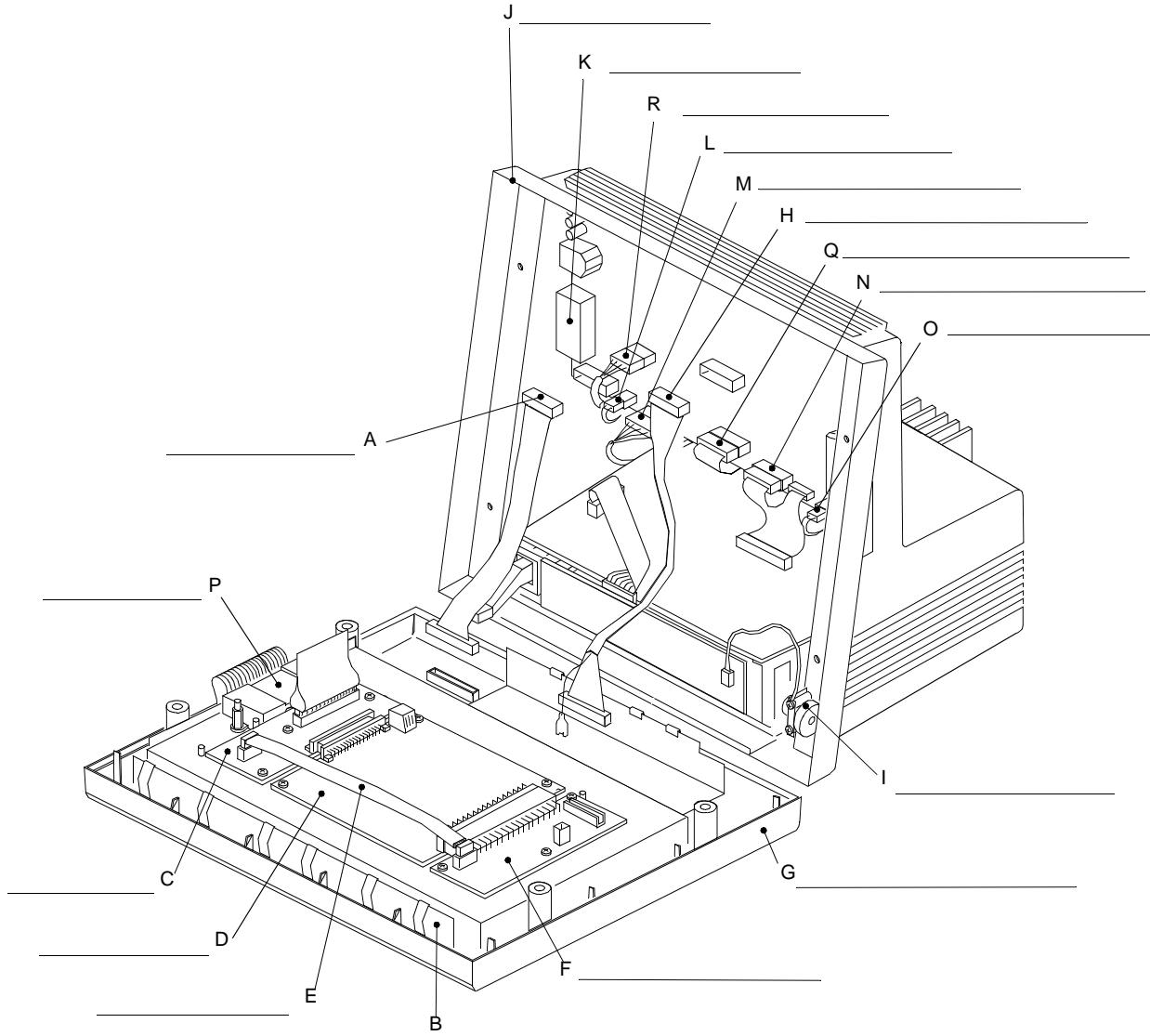
- 4 Replace Front Housing Assembly.

## Replacing Lead-Acid Batteries

- 1 Remove power to the instrument by pressing the power switch to OFF and disconnecting the AC power cord.
- 2 At rear of the instrument, open battery door (swings downward).
- 3 Slide lead-acid battery into chamber until it snaps into place. Repeat for other battery if necessary.

## Practice Exercise

To check your understanding, please complete the following exercise. Write the name of each assembly in the space provided which correspond to each letter shown in the illustration. After naming each replaceable assembly, check your answer with the answers provided on the following page.



## **Practice Exercise Answers**

- A. Keypad Cable
- B. Flat Panel Bracket
- C. Flat Panel Adapter Board
- D. DSPC Board
- E. 12v Cable
- F. CDCI Board
- G. Front Housing
- H. Flat Panel Data Cable
- I. Flat Panel Brightness Control Assembly
- J. Rear Housing
- K. Front End Link Cable Connector
- L. 60v Cable
- M. RS232 Cable
- N. 5v/12v Power Supply Cable
- O. Speaker Cable.
- P. Flat Panel Cable (w/ferrite block)
- Q. Docking Connector Cable
- R. SDN Cable



*Agilent M1205A V24/V26 Series Service Guide*

# Chapter 9 Front Housing Assembly V24C/V26C & V24CT/V26CT

## Objective

After reading this chapter and completing the Practice Exercise you will be able to **remove** and **replace** the following Agilent Model V24C/V26C/V24CT/V26CT major assemblies:

- Front Housing Assembly and major components

## In this chapter

The removal and replacement procedures for the instrument are easy to complete when following the step-by-step procedures. There are three parts to this chapter; namely, disassembly, reassembly and practice exercises. At the end of this chapter complete the practice exercise to check your understanding of how to remove and replace the key field-replaceable assemblies.

Topics in this Chapter	See Page	Topics in this Chapter	See Page
<b><i>Front Housing Removal Procedures</i></b>		<b><i>Front Housing Replacement Procedures</i></b>	
Removing the Front Housing Assembly	9-2	Replacing Front Housing Keypad	9-26
Version 1: Assembly procedure for Display Options 021 to 025 and J90 with PDC 3931 or greater	9-5	Replacing the Flat Panel Backlight	9-26
Version 2: Assembly Procedure for Display Options 026 to 029 less than PDC 3927	9-13	Replacing the Flat Panel	9-28
Version 3&4: Assembly Procedure for Display Options 027 and 028 with PDC 3927 and above	9-19	Replacing the 3-Board Assembly	9-29
Front Housing Replacement Procedures	9-25	Replacing the Flat Panel Display Assembly	9-31
		Replacing the Front Housing Assembly	9-32
		Replacing the Board Shield	9-34
		Replacing Parameter Module Rack Assembly (M1276-60001)	9-34
		Replacing Lead-Acid Batteries (CT model)	9-34
		Practice Exercise	9-35

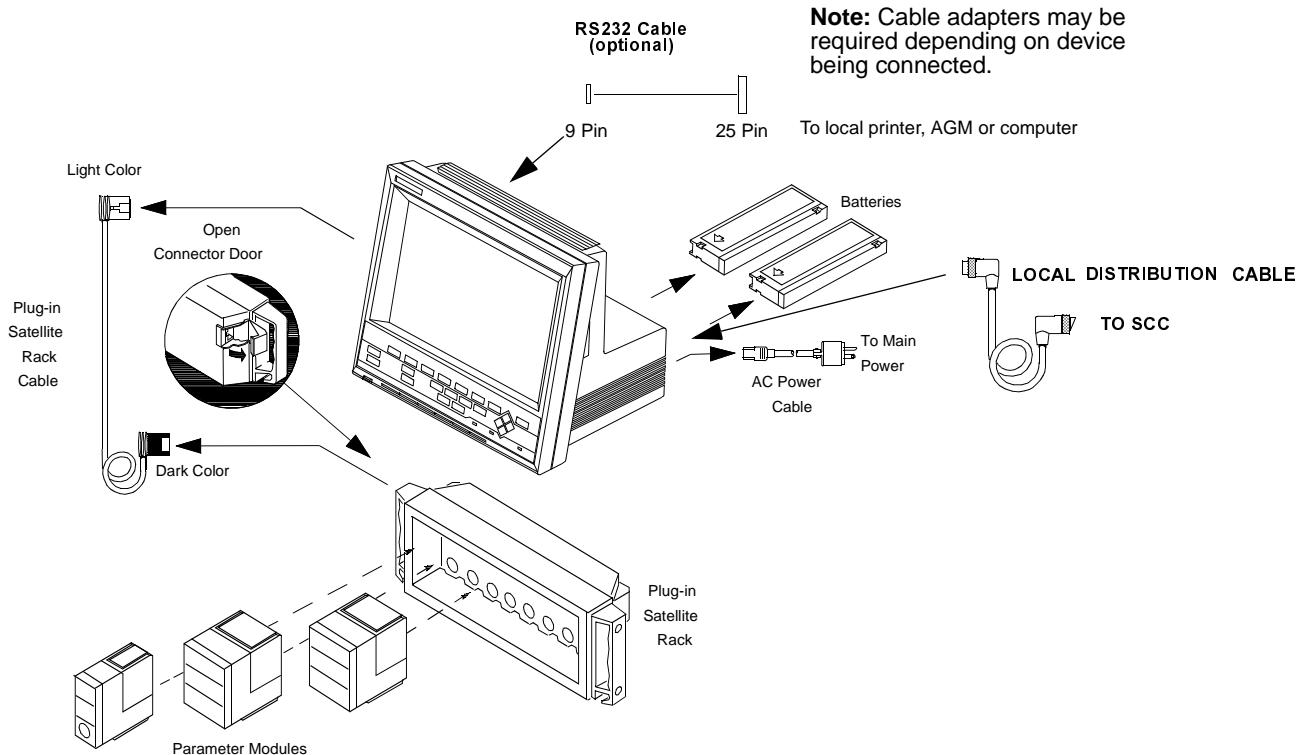
## Removing the Front Housing Assembly

### WARNING

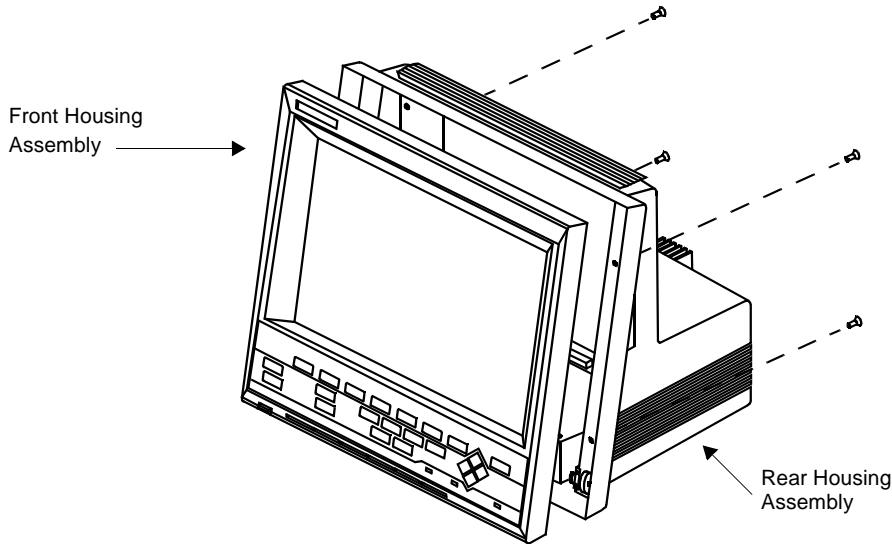
**High Voltage - Voltages dangerous to life are present in the instrument. Do not perform any disassembly or reassembly procedures (other than parameter module removal) with power applied to the instrument. Failure to adhere to this warning could cause serious injury or death.**

### To remove the front housing assembly:

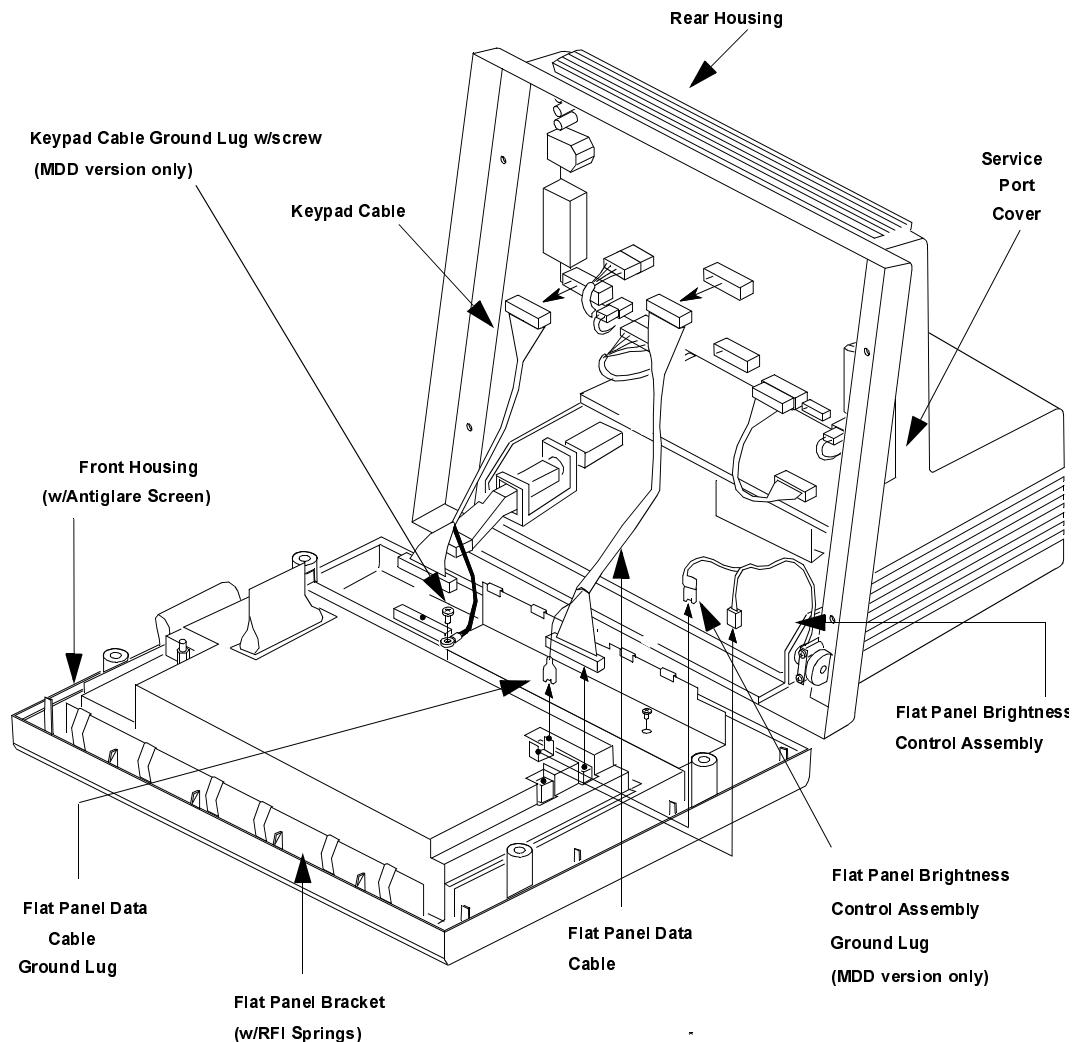
- 1 Remove power to the Model V24C/V26C/V24CT/V26CT by pressing the power switch to OFF and disconnecting the AC power cord.
- 2 Remove lead acid batteries if it is a CT model.
- 3 Remove the Parameter Module Rack.
- 4 Disconnect the Plug-in Satellite Rack cable and Defib sync cable.



- 5** Remove the 4 screws from the rear of the front housing assembly. Separate front housing assembly from rear housing and continue to hold the front housing assembly for support.



- 6** While supporting the front housing assembly, disconnect the Flat Panel data cable from the System board.  
**7** Disconnect the brightness knob connector from the Display Adapter Board.  
**8** Disconnect the keyboard cable from the system board.

**9** Lay the display down on a flat surface.**NOTE**

If your monitor has a new type of flat screen display it will look slightly different from the above picture. There are 4 different types of displays, each of which requires its own disassembly procedure. You can check which display you have by looking at the option number and Prefix Date Code of the serial number located on the right-hand side of the monitor.

Use the following table to check which of the assembling procedures applies for your display type.

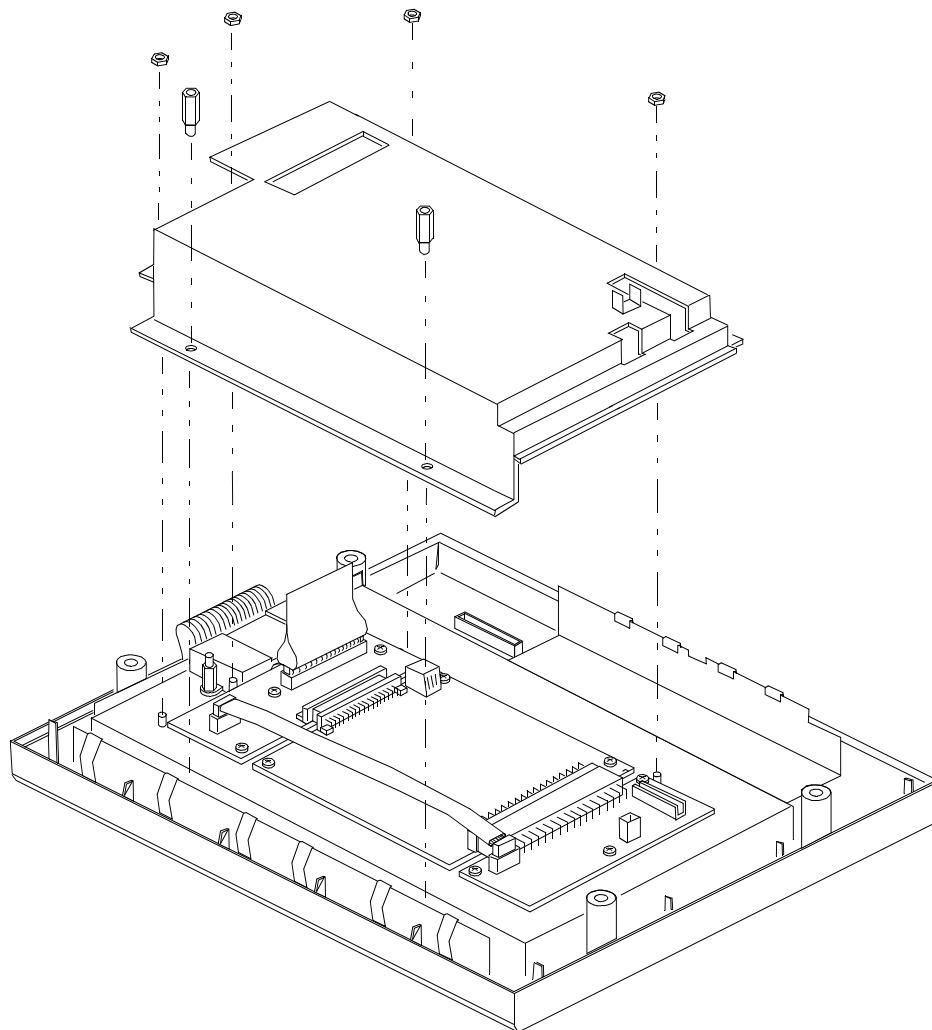
Option	Prefix Date Code	Version
021 to 025	—	1
J90	3931 or greater	
026 to 029	Less than 3927	2
027 and 028	3927 or greater	3
027 and 028	3931 or greater	4

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## Version 1: Assembly procedure for Display Options 021 to 025 and J90 with PDC 3931 or greater

### Removing the Board Shield

- 1 Remove the Front Housing Assembly (see "Removing the Front Housing Assembly" on page 9-2).
- 2 Remove the 2 hex stand-off screws (5 mm) located in the narrow channel securing the Board Shield and Flat Panel Bracket to the top of the Front Housing.
- 3 Remove the 4 hex nuts (5.5mm) securing the rest of the Board Shield to the Flat Panel Bracket.
- 4 Lift Board Shield up and away from the Flat Panel Bracket.



## Removing the Flat Panel Display Assembly

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**CAUTION**

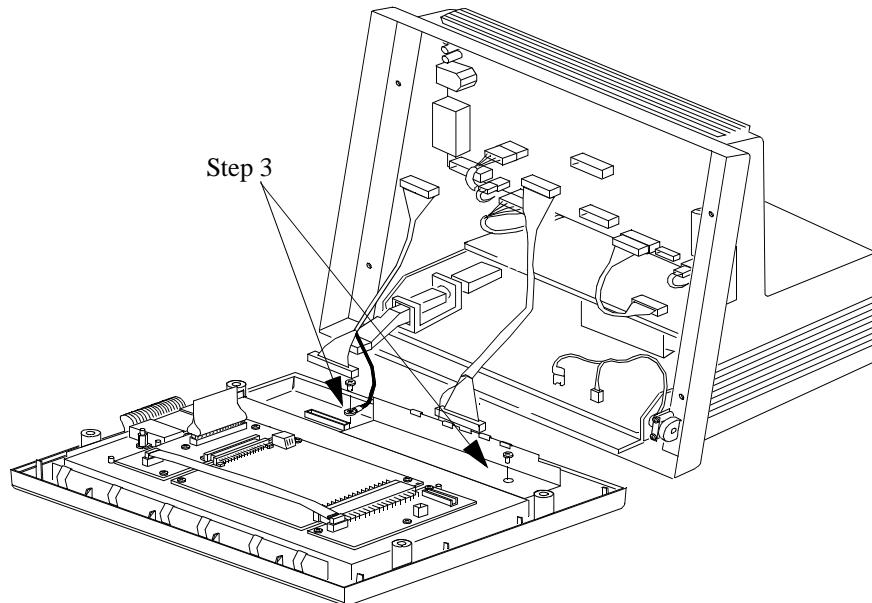
Fingerprints and dirt between the Flat Panel Display and plastic antiglare screen show up prominently during instrument operation. Take care not to touch the Flat Panel screen or the inside of the clear plastic antiglare screen. Remove any fingerprints or dirt using a non-residue-forming cleaner (such as alcohol) and a lint-free cloth.

- 1 Remove Front Housing Assembly (see page 9-2).
- 2 It is not necessary to completely remove the Board Shield to remove the Flat Panel Display Assembly. Just remove the 2 hex stand-off screws (see step 2, "Removing the Board Shield" on page 9-5). If you already removed the Board Shield, proceed to the next step.
- 3 Remove the screw securing the Flat Panel Bracket to the Front Housing.

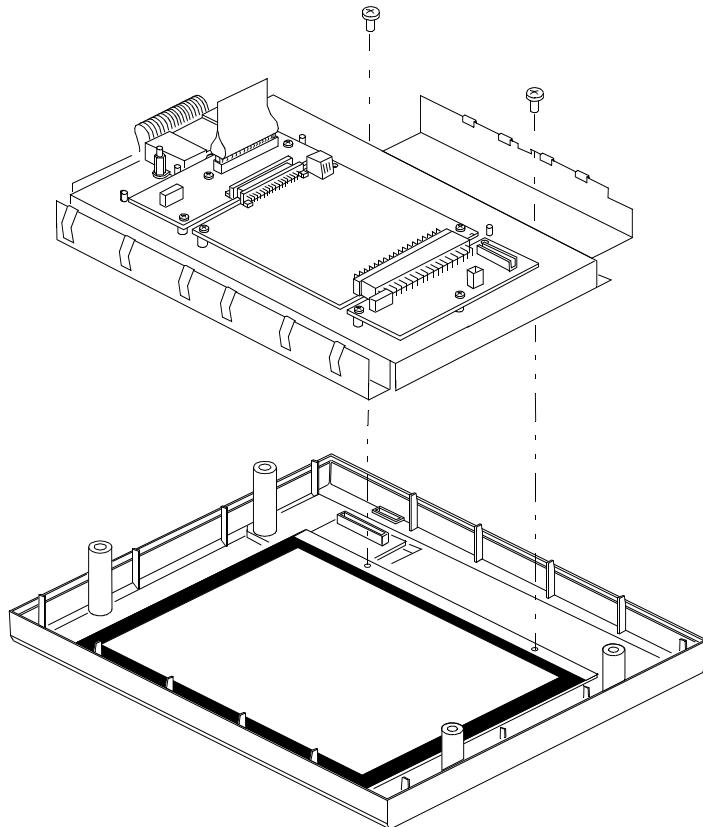
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**NOTE**

For the Standard version of the instrument, (i.e., no ground lug on Keypad cable) also remove the screw next to the Keypad securing the Flat Panel Bracket to the Front Housing.



- 4 Gently lift up on the Flat Panel Bracket containing the Flat Panel and remove it from the Front Housing.

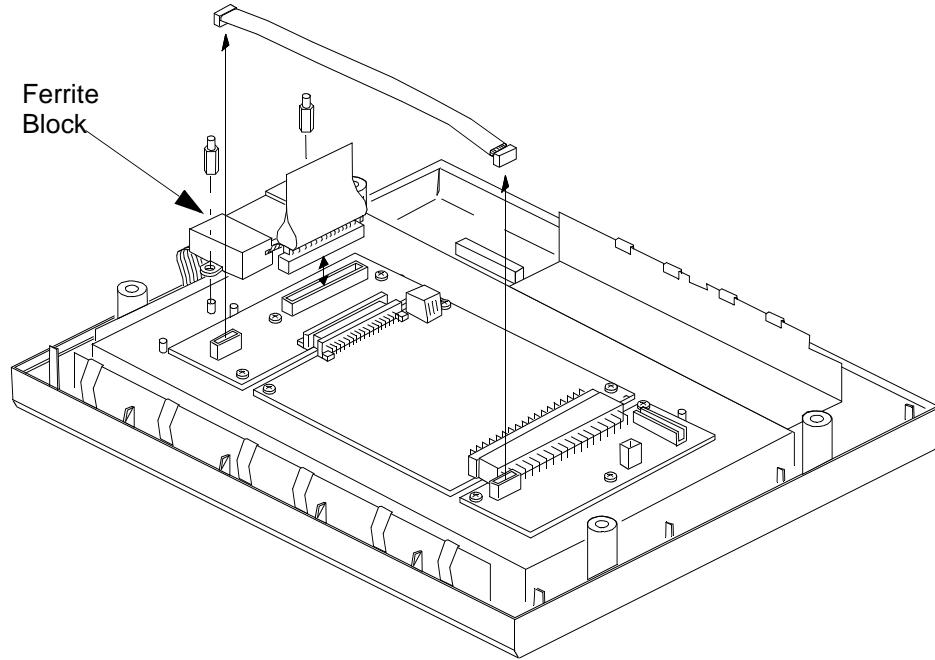


## Removing the 3-Board Assembly

**NOTE**

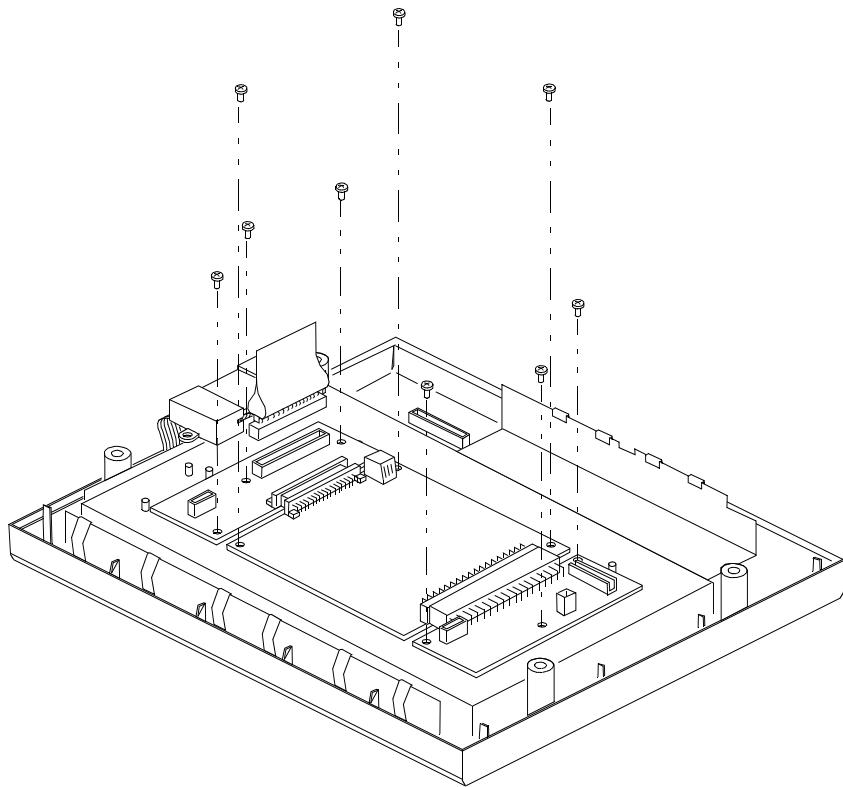
The 3-Board Assembly consists of the DSPC Board, CDCI Board, and Flat Panel Adapter Board.

- 1 Remove the Board Shield (see page 9-5).
- 2 Remove the 2 hex stand-off nuts securing the ferrite block and wide Flat Panel Ribbon Cable to the Flat Panel Bracket.
- 3 Gently pull up on the white connector pull-tab and lift the ferrite block and ribbon cable off the threaded studs on the Flat Panel Bracket.
- 4 Lay the ribbon cable assembly over the edge of the Front Housing.
- 5 Disconnect the 12V cable connecting the CDCI Board to the Flat Panel Adapter Board.

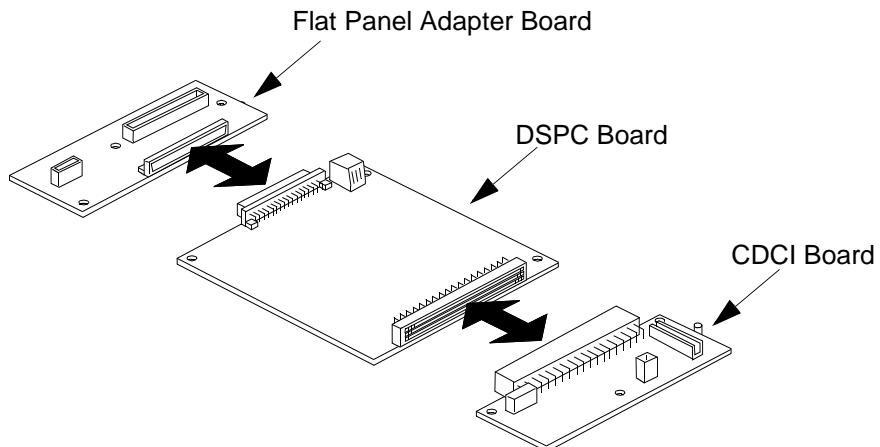


- 6 Remove the 3-Board assembly by:

- a. Removing the 3 screws securing the middle DPSC board to the Flat Panel Bracket.
- b. Removing the six screws securing the CDCI Board and the Flat Panel Adapter Board to the Flat Panel Bracket.



- c. Lifting the entire 3-board assembly off the Flat Panel assembly.
- 7 If necessary to remove individual boards from the board assembly, grip either the CDCI Board or the Flat Panel Adapter Board securely and gently pull so that the board connector separates from the DSPC board.



## Removing the Flat Panel

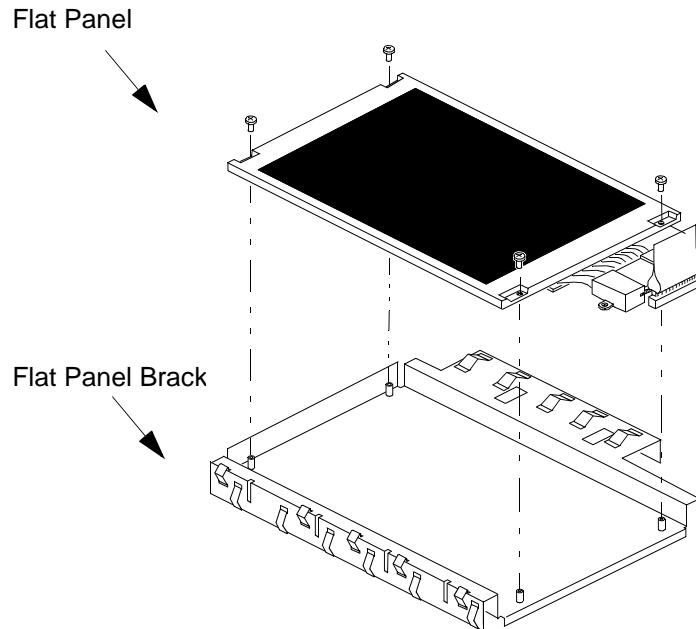
- 1 Remove the Front Housing Assembly. See "Removing the Front Housing Assembly" on page 9-2.
- 2 Remove the Flat Panel Display Assembly. See "Removing the Flat Panel Display Assembly" on page 9-6.
- 3 Remove the Board Shield. See "Removing the Board Shield" on page 9-5.
- 4 Remove the Flat Panel cable (w/ferrite block) from the Flat Panel Adapter Board. (It is not necessary to remove the 3-Board Assembly.)
- 5 Turn the Flat Panel Display Assembly over and lay on a clean flat surface (Display side up).

---

**CAUTION**

Fingerprints and dirt between the Flat Panel Display and plastic antiglare screen show up prominently during instrument operation. Take care not to touch the Flat Panel screen or the inside of the clear plastic antiglare screen. Remove any fingerprints or dirt using a non-residue-forming cleaner (such as alcohol) and a lint-free cloth.

- 6 Remove 4 screws securing the Flat Panel to the Flat Panel Bracket



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**NOTE**

If the Flat Panel is being replaced, remove the ribbon cable with ferrite block from the Flat Panel and move it to the replacement Flat Panel. The (4) connectors to the Flat Panel are keyed and can be carefully removed with a small flat-bladed screwdriver.

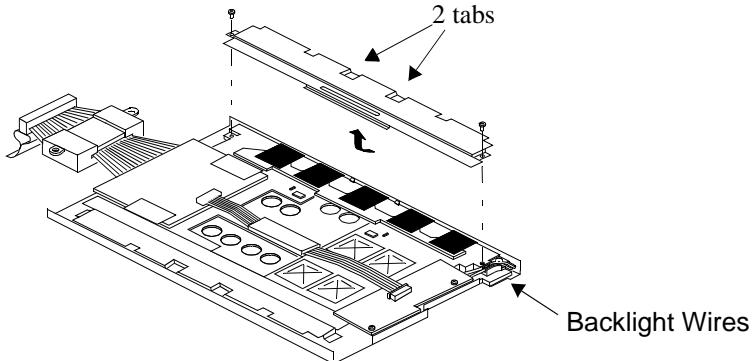
## Removing the Flat Panel Backlight Tube

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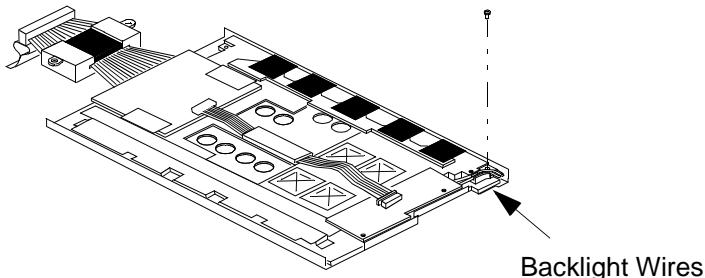
**NOTE**

When removing backlight, carefully place the Flat Panel with display side down on a clean flat surface.

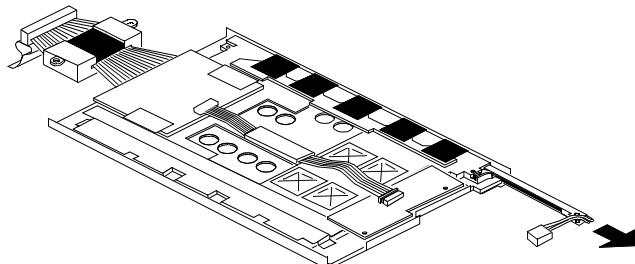
- 1 Using a jeweler size Phillips screwdriver, remove the backlight cover housing the 2 backlight wires by unscrewing the 2 screws.
- 2 Push up on 2 tabs to release cover and slide cover forward and up to remove.



- 3 Unscrew the small screw next to the 2 backlight wires to disconnect the backlight assembly from the Flat Panel.



- 4 Lift the 2 backlight wires from their channels and pull gently to remove the backlight's connector from the Flat Panel.
- 5 Gently slide the backlight out from its channel.



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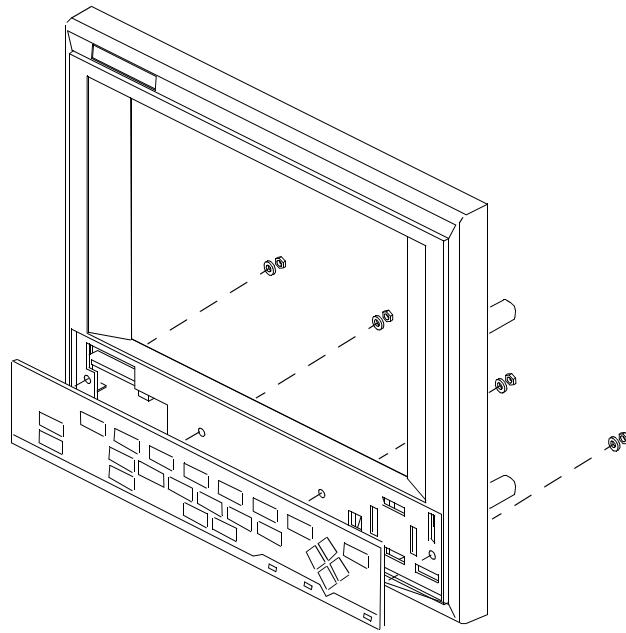
**NOTE**

Do not touch fluorescent tube when removing or installing the backlight as oil from fingerprints will shorten the operating life of the tube.

Now continue the disassembly procedure on page 9-12.

## Remove the Front Housing Keypad

- 1 Remove the Front Housing Assembly. See "Removing the Front Housing Assembly" on page 9-2.
- 2 Remove four nuts securing Keypad to the Front Housing.
- 3 Remove Keypad from Front Housing.



---

**NOTE**

To **reassemble** the unit, follow the disassembly procedures in reverse order.

---

**WARNING**

**High Voltage — Voltages dangerous to life are present in the instrument. Do not perform any disassembly, reassembly or replacement procedures (other than parameter module removal) with power applied to the instrument. Failure to adhere to this warning could cause serious injury or death.**

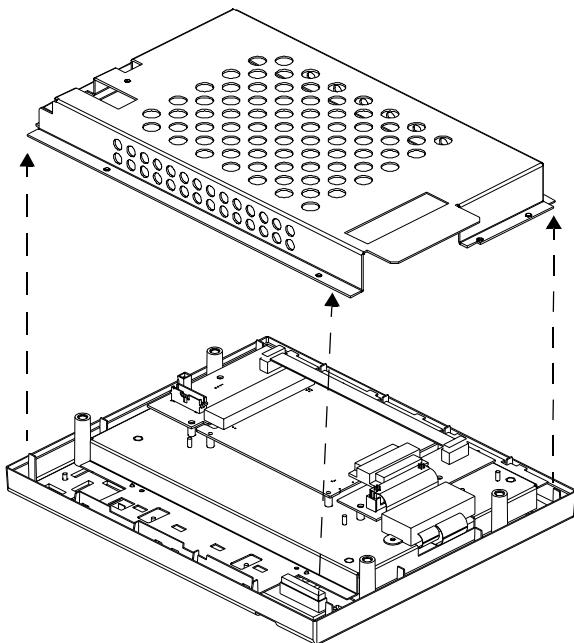
Following reassembly, perform the appropriate safety checks.

---

## Version 2: Assembly Procedure for Display Options 026 to 029 less than PDC 3927

### Removing the Board Shield

- 1 Remove the Front Housing Assembly (see "Removing the Front Housing Assembly" on page 9-2).
- 2 Remove the two screws located in the narrow channel and the two hex stand-off screws securing the Board Shield and Flat Panel Bracket to the top of the Front Housing.
- 3 Remove the 4 hex nuts (5.5mm) securing the rest of the Board Shield to the Flat Panel Bracket.
- 4 Lift Board Shield up and away from the Flat Panel Bracket.



## Removing the Flat Panel Display Assembly

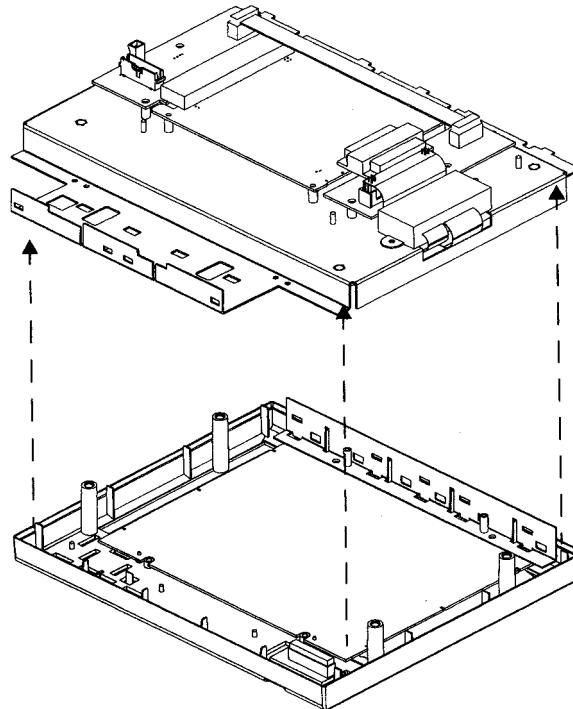
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### CAUTION

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Fingerprints and dirt between the Flat Panel Display and plastic antiglare screen show up prominently during instrument operation. Take care not to touch the Flat Panel screen or the inside of the clear plastic antiglare screen. Remove any fingerprints or dirt using a non-residue-forming cleaner (such as alcohol) and a lint-free cloth.

- 1 Remove Front Housing Assembly (see page 9-2).
- 2 It is not necessary to completely remove the Board Shield to remove the Flat Panel Display Assembly. Just remove the two screws located in the narrow channel and the two hex stand-off screws (see step 2, "Removing the Board Shield" on page 9-13). If you already removed the Board Shield, proceed to the next step.
- 3 Gently lift up on the Flat Panel Bracket containing the Flat Panel and remove it from the Front Housing.



## Removing the 3-Board Assembly

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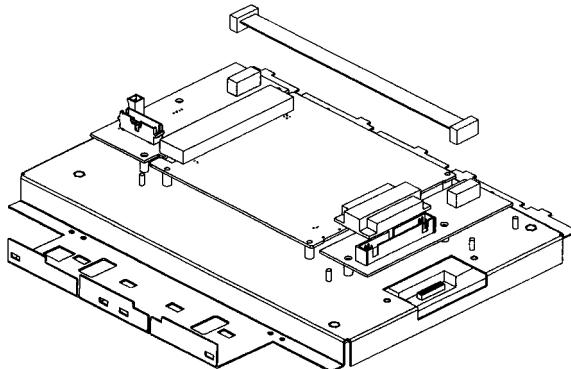
### NOTE

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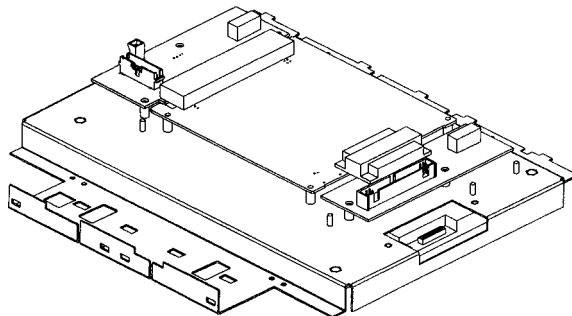
To remove the flat panel it is not necessary to remove the 3-Board Assembly. The 3-Board Assembly consists of the DSPC Board, CDCI Board, and Flat Panel Adapter Board.

- 1 Remove the Board Shield.
- 2 Remove the two screws securing the ferrite block and wide Flex Cable to the Flat Panel Bracket.
- 3 Carefully disconnect the flex cable connector (do not pull on the flex cable); then gently lift the ferrite block and flex cable off the threaded studs on the Flat Panel Bracket.

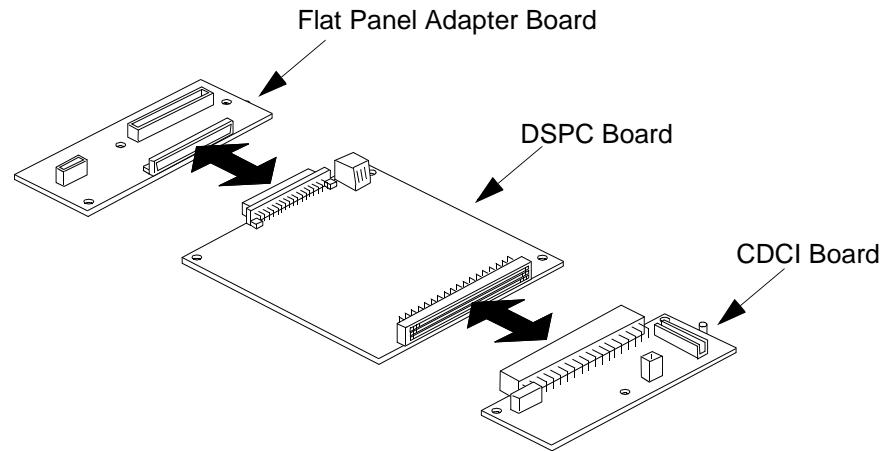
- 4** Lay the flex cable assembly over the edge of the Front Housing.
- 5** Disconnect the 12V cable connecting the CDCI Board to the Flat Panel Adapter Board.



- 6** Remove the 3-Board assembly by:
  - a. Removing the 3 screws securing the middle DPSC board to the Flat Panel Bracket.
  - b. Removing the six screws securing the CDCI Board and the Flat Panel Adapter Board to the Flat Panel Bracket.



- c.** Lifting the entire 3-board assembly off the Flat Panel assembly.
- 7** If necessary to remove individual boards from the board assembly, grip either the CDCI Board or the Flat Panel Adapter Board securely and gently pull so that the board connector separates from the DSPC board.



### Removing the Flat Panel

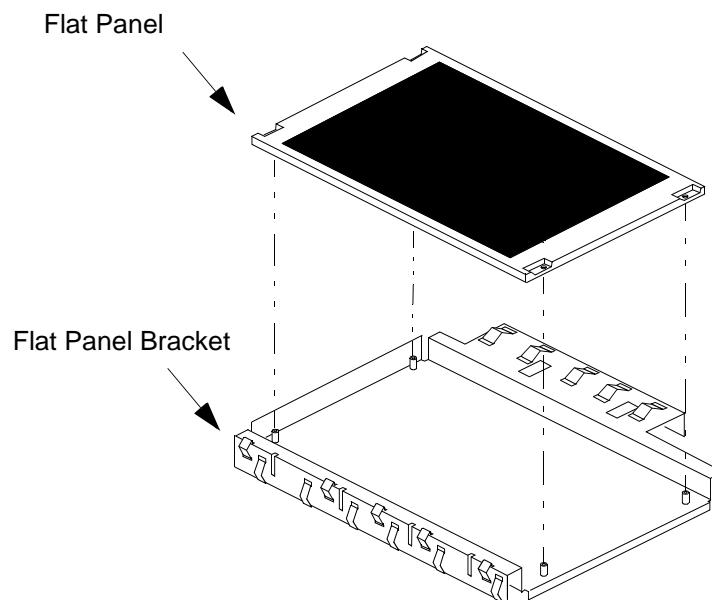
- 1 Remove the Front Housing Assembly.
- 2 Remove the Flat Panel Display Assembly.
- 3 Turn the Flat Panel Display Assembly over and lay on a clean flat surface (Display side up).

---

**CAUTION**

Fingerprints and dirt between the Flat Panel Display and plastic antiglare screen show up prominently during instrument operation. Take care not to touch the Flat Panel screen or the inside of the clear plastic antiglare screen. Remove any fingerprints or dirt using a non-residue-forming cleaner (such as alcohol) and a lint-free cloth.

- 4 Remove 4 screws securing the Flat Panel to the Flat Panel Bracket
- 5 Remove the 3-wire backlight cable connector and the Flat Panel cable (flex cable with ferrite block) from the Flat Panel Adapter Board.
- 6 Carefully, using a small flat-bladed screwdriver, disconnect the flex cable with ferrite block from the Flat Panel.



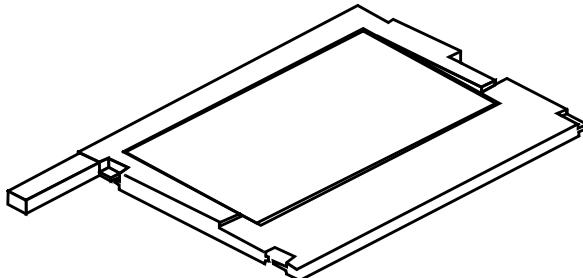
## Removing the Flat Panel Backlight Tube

### Without fully disassembling the Front Housing

- 1 Remove the Front Housing Assembly.
- 2 Remove the Flat Panel Display Assembly.
- 3 Turn the Flat Panel Display Assembly over and lay on a clean flat surface (Display side up) with the 3-wire backlight cable connector side facing you.
- 4 Remove the two screws (securing the flat panel to the flat panel bracket) at the end nearer to you.
- 5 *Loosen* the two screws at the other end.
- 6 Carefully remove the 3-wire backlight cable from the Flat Panel Adapter Board.
- 7 Gently lift the near end of the Flat Panel.
- 8 Using your fingernail or a small flat-bladed screwdriver, press the tiny black clip holding the backlight in its channel.
- 9 By gently tugging on the 3-wire connector, slide the backlight out from its channel.

### If Front Housing is fully disassembled

- 1 Carefully place the Flat Panel with display side down on a clean flat surface.
- 2 Using your fingernail or a small flat-bladed screwdriver, press the tiny black clip holding the backlight in its channel.
- 3 By gently tugging on the 3-wire connector, slide the backlight out from its channel.



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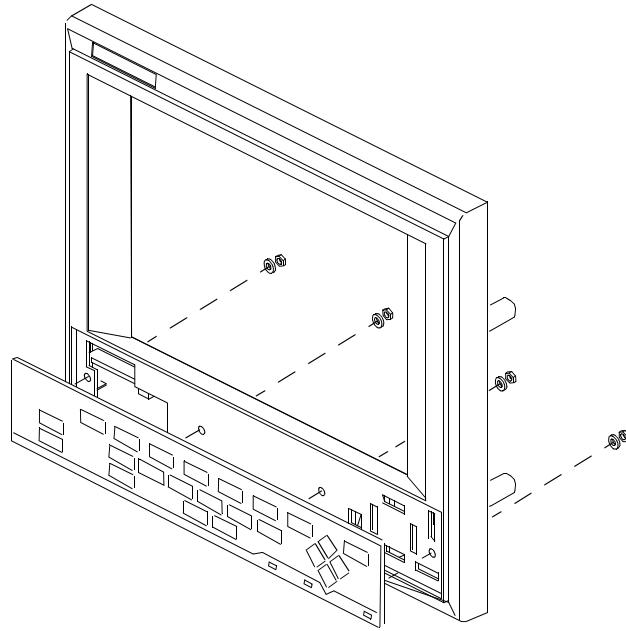
**NOTE**

Do not touch fluorescent tube when removing or installing the backlight as oil from fingerprints will shorten the operating life of the tube.

Now continue the disassembly procedure on page 9-18

## Remove the Front Housing Keypad

- 1 Remove the Front Housing Assembly. See "Removing the Front Housing Assembly" on page 9-2.
- 2 Remove four nuts securing Keypad to the Front Housing.
- 3 Remove Keypad from Front Housing.



---

**NOTE**

To **reassemble** the unit, follow the disassembly procedures in reverse order.

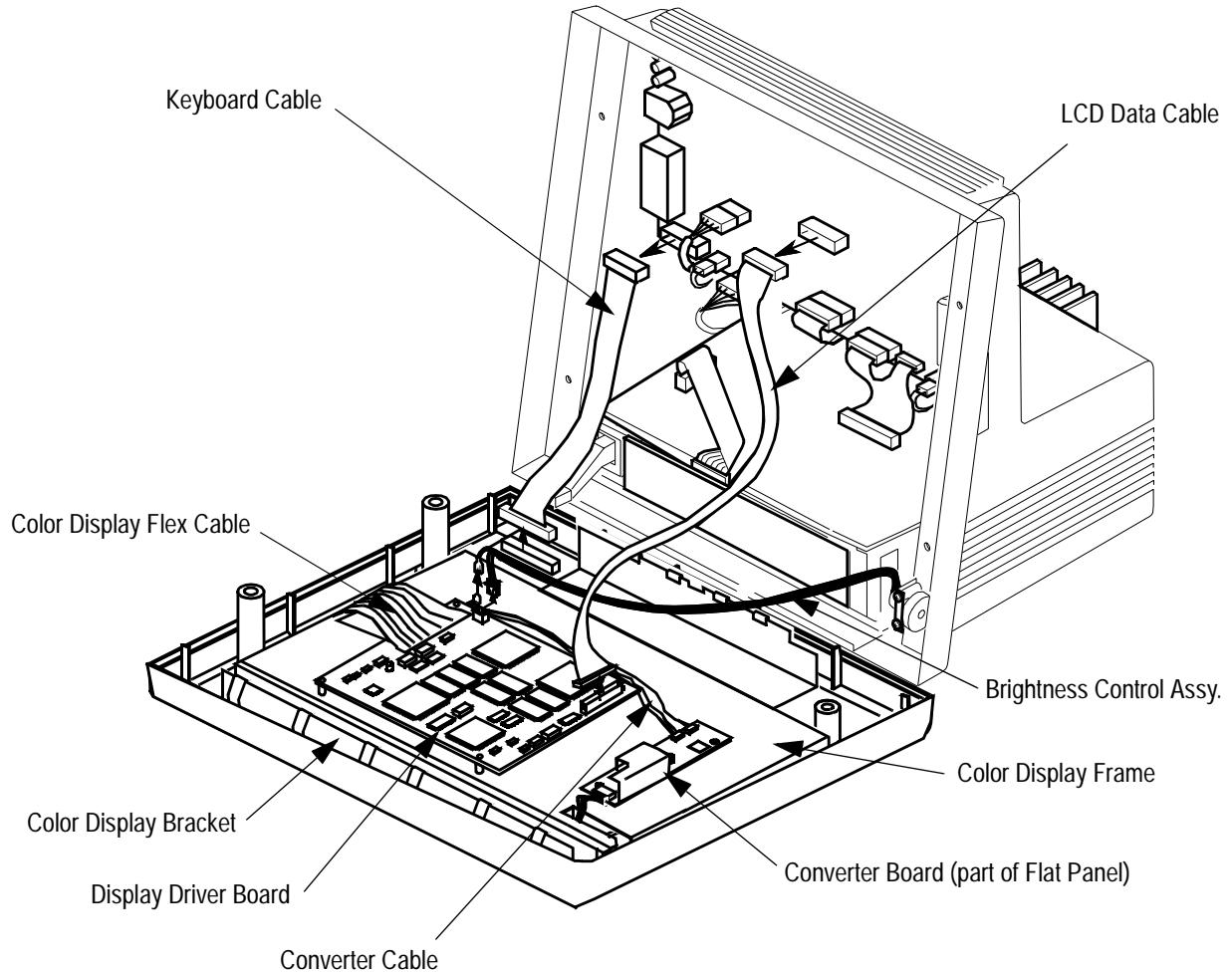
---

**WARNING**

**High Voltage — Voltages dangerous to life are present in the instrument. Do not perform any disassembly, reassembly or replacement procedures (other than parameter module removal) with power applied to the instrument. Failure to adhere to this warning could cause serious injury or death.**

Following reassembly, perform the appropriate safety checks.

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**Version 3&4: Assembly Procedure for Display Options 027 and 028 with PDC 3927 and above**

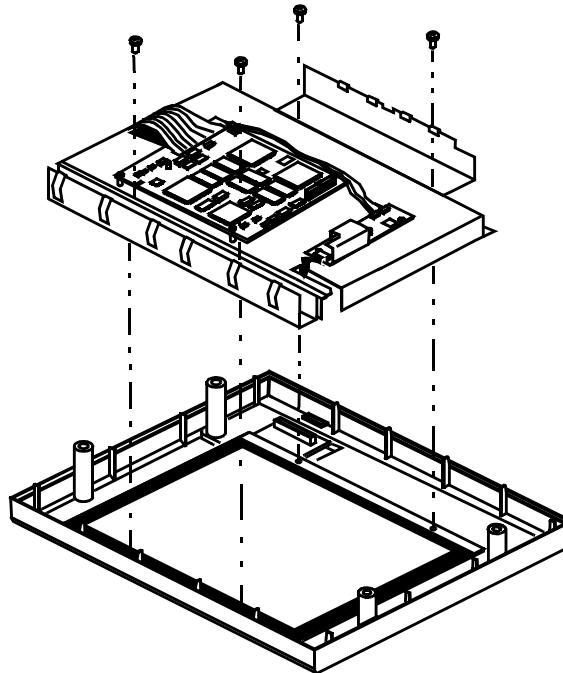
The newest front housing assembly (PDC = 3927 or greater) has no board shield.

## Removing the Flat Panel Display Assembly

### CAUTION

Fingerprints and dirt between the Flat Panel Display and plastic antiglare screen show up prominently during instrument operation. Take care not to touch the Flat Panel screen or the inside of the clear plastic antiglare screen. Remove any fingerprints or dirt using a non-residue-forming cleaner (such as alcohol) and a lint-free cloth.

- 1 Remove Front Housing Assembly (see "Removing the Front Housing Assembly" on page 9-2).
- 2 Remove the four screws holding the flat panel display assembly to the front housing. (Refer to following picture.)
- 3 Gently lift up on the Flat Panel Bracket containing the Flat Panel and remove it from the Front Housing.



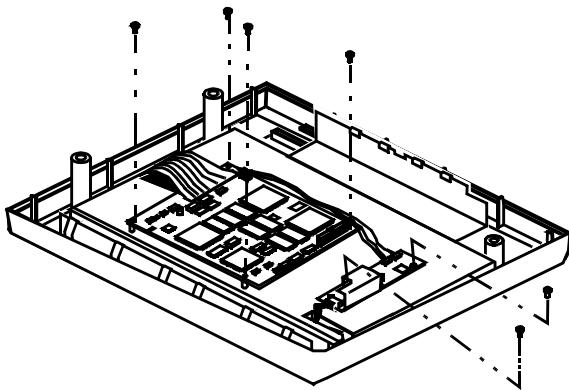
## Removing the Display Driver Board and Converter Assemblies

---

**NOTE**

To remove the flat panel it is not necessary to remove the Display Driver and Converter Boards.

- 1 Carefully disconnect the flex cable connector from the Display Driver Board.



- 2 To remove the Display Driver Board, remove the four screws securing it to the flat panel frame.
- 3 To remove the Converter Board, disconnect the two black cables on the side of the board and disconnect the 3-wire backlight cable from the connector on the end of the board.

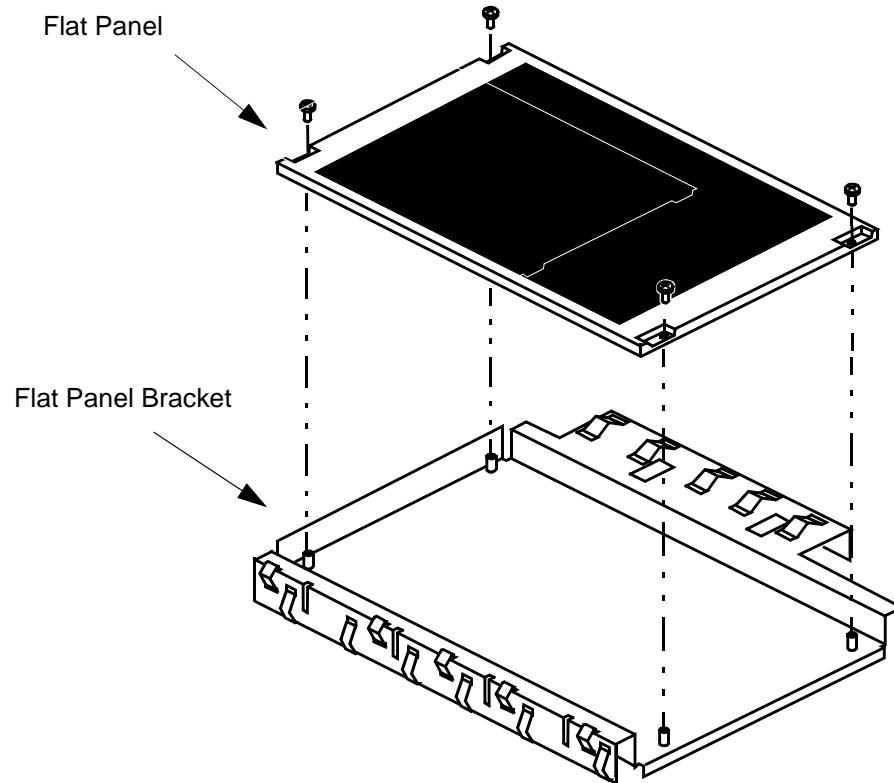
## Removing the Flat Panel

---

**CAUTION**

Fingerprints and dirt between the Flat Panel Display and plastic antiglare screen show up prominently during instrument operation. Take care not to touch the Flat Panel screen or the inside of the clear plastic antiglare screen. Remove any fingerprints or dirt using a non-residue-forming cleaner (such as alcohol) and a lint-free cloth.

- 1 Remove the Front Housing Assembly.
- 2 Disconnect the 3-wire backlight cable from the Converter Board.
- 3 Remove the flex circuit cable from Display Driver Board.
- 4 Disconnect flex circuit connector from Flat Panel Display.
- 5 Remove the Flat Panel Display Assembly.
- 6 Turn the Flat Panel Display onto a clean flat surface.
- 7 Remove the four screws securing the Flat Panel Display to the frame assembly.



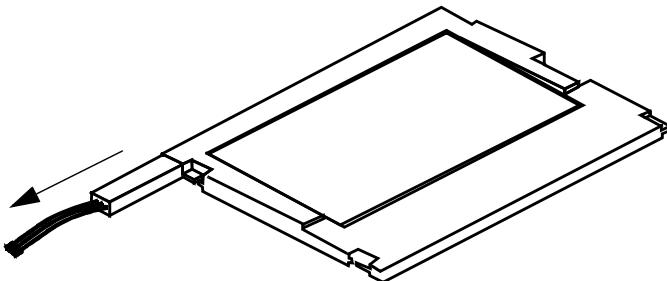
## Removing the Flat Panel Backlight Tube

### Without fully disassembling the Front Housing

- 1 Remove the Front Housing Assembly.
- 2 Disconnect the large flex cable from Display Driver Board and remove the flex circuit connector from Flat Panel Display.
- 3 Disconnect the 3-wire backlight cable from the end of the Converter Board.
- 4 Remove the Flat Panel Display Assembly.
- 5 Turn the Flat Panel Display onto a clean flat surface with display side up.
- 6 Remove the two screws (securing the flat panel to the flat panel bracket) at the end nearer to you.
- 7 *Loosen* the two screws at the other end.
- 8 Gently lift the near end of the Flat Panel.
- 9 Using your fingernail or a small flat-bladed screwdriver, press the tiny black clip holding the backlight in its channel.
- 10 By gently tugging on the 3-wire connector, slide the backlight out from its channel.

### If Front Housing is fully disassembled

- 1 Carefully place the Flat Panel with display side down on a clean flat surface.
- 2 Using your fingernail or a small flat-bladed screwdriver, press the tiny black clip holding the backlight in its channel.
- 3 By gently tugging on the 3-wire connector, slide the backlight out from its channel.



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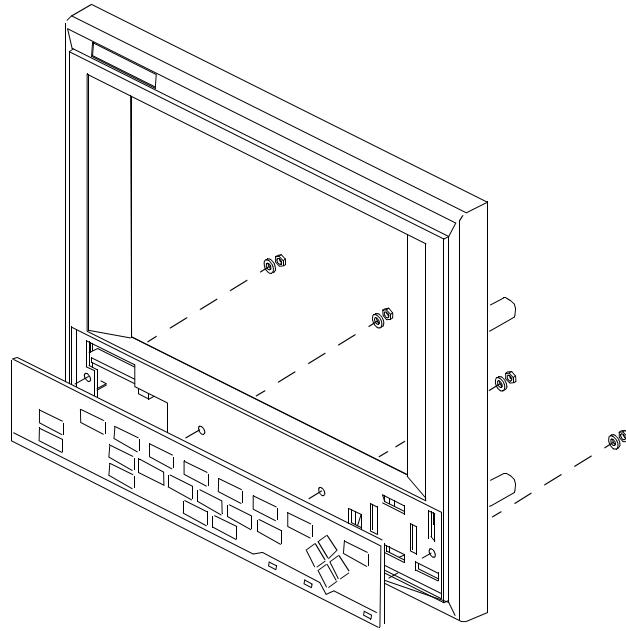
**NOTE**

Do not touch fluorescent tube when removing or installing the backlight as oil from fingerprints will shorten the operating life of the tube.

Now continue the disassembly procedure on page 9-24.

## Remove the Front Housing Keypad

- 1 Remove the Front Housing Assembly. See "Removing the Front Housing Assembly" on page 9-2.
- 2 Remove four nuts securing Keypad to the Front Housing.
- 3 Remove Keypad from Front Housing.



---

**NOTE**

To **reassemble** the unit, follow the disassembly procedures in reverse order.

---

**WARNING**

**High Voltage — Voltages dangerous to life are present in the instrument. Do not perform any disassembly, reassembly or replacement procedures (other than parameter module removal) with power applied to the instrument. Failure to adhere to this warning could cause serious injury or death.**

Following reassembly, perform the appropriate safety checks.

## Front Housing Replacement Procedures

If your monitor has the new type (Version 2 to 4) of flatscreen display some of the reassembly procedures may be slightly different from the following sections. Refer back to the disassembly procedures for the detailed differences. You can check which display you have by looking at the option number and Prefix Date Code of the serial number located on the right-hand side of the monitor.

Use the following table to check which procedure applies for your display type.

Option	Prefix Date Code	Version
021 to 025	—	<b>1</b>
J90	3931 or greater	
026 to 029	Less than 3927	<b>2</b>
027 and 028	3927 or greater	<b>3</b>
027 and 028	3931 or greater	<b>4</b>

The procedures described in this section begin with the instrument's power turned off and the instrument disassembled.

### **WARNING**

**High Voltage - Voltages dangerous to life are present in the instrument. Do not perform any assembly procedures (other than parameter module installation) with power applied to the instrument. Failure to adhere to this warning could cause serious injury or death.**

The replacement procedures are listed in the order they would occur should the front housing require complete reassembly.

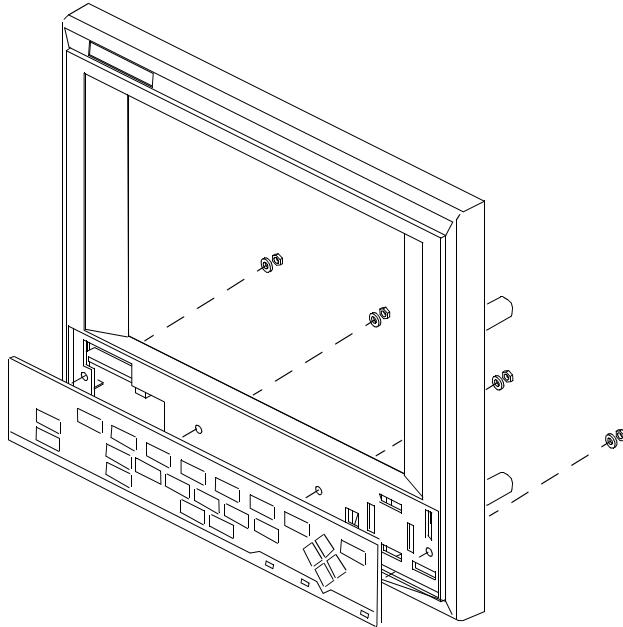
Should complete reassembly not be necessary, follow the procedures below only to the point required.

Reassembly of the front housing assembly consists of the following procedures:

- 1 Verify power to the monitor is OFF and that the AC power cord is disconnected.
- 2 If it is a CT model, verify that the Lead-Acid batteries have been removed.
- 3 Replace Front Housing Keypad.
- 4 Replace Flat Panel.
- 5 Replace Backlight Fluorescent Tube.
- 6 Replace the 3-Board Assembly.
- 7 Replace Front Housing Assembly.
- 8 Replace Parameter Module Rack
- 9 Replace Lead Acid Batteries

## Replacing Front Housing Keypad

- 1 Verify power to the monitor is OFF and that the AC power cord is disconnected.
- 2 If it is a CT model, verify that the Lead-Acid batteries have been removed.
- 3 Insert the keypad onto the Front Housing.
- 4 Replace four nuts securing Keypad to the Front Housing.
- 5 Install the Flat Panel Display Assembly.
- 6 Install the Front Housing Assembly.



## Replacing the Flat Panel Backlight

If your monitor has the new flat screen display some of the reassembly procedures will be slightly different from the following sections. Refer back to the disassembly procedures (page 9-13 to page 9-17) for the detailed differences. You can check which display you have by looking at the serial number on the right-hand side of the monitor. Options 026, 027, 028 and 029 have the new display. All other options (020 - 025) have the old display.

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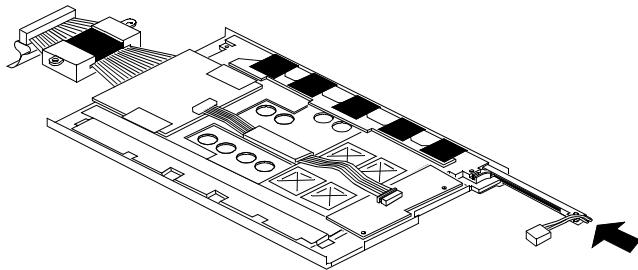
**NOTE** When installing the backlight, carefully place the Flat Panel Display with display side down on a clean flat surface.

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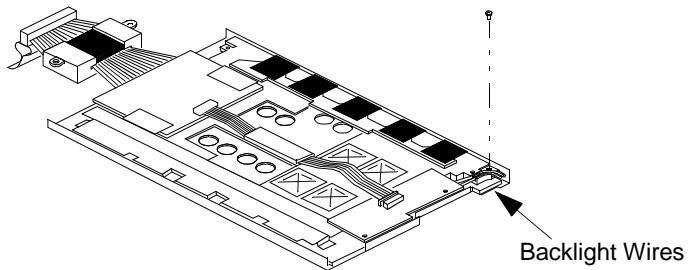
**NOTE** Do not touch fluorescent tube when removing or installing the backlight as oil from finger prints will shorten the operating life of the tube.

- 1 Verify power to the monitor is OFF and that the AC power cord is disconnected.
- 2 If it is a CT model, verify that the Lead-Acid batteries have been removed.

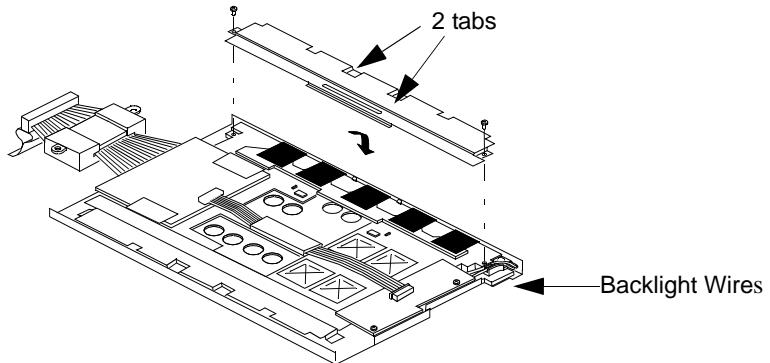
- 3 Gently slide the backlight into its channel.



- 4 Using a small flat-bladed screwdriver, plug the backlight connector into the Flat Panel and reposition the 2 backlight wires into their channels.
- 5 Screw in the screw next to the 2 backlight wires to secure the backlight to the Flat Panel.

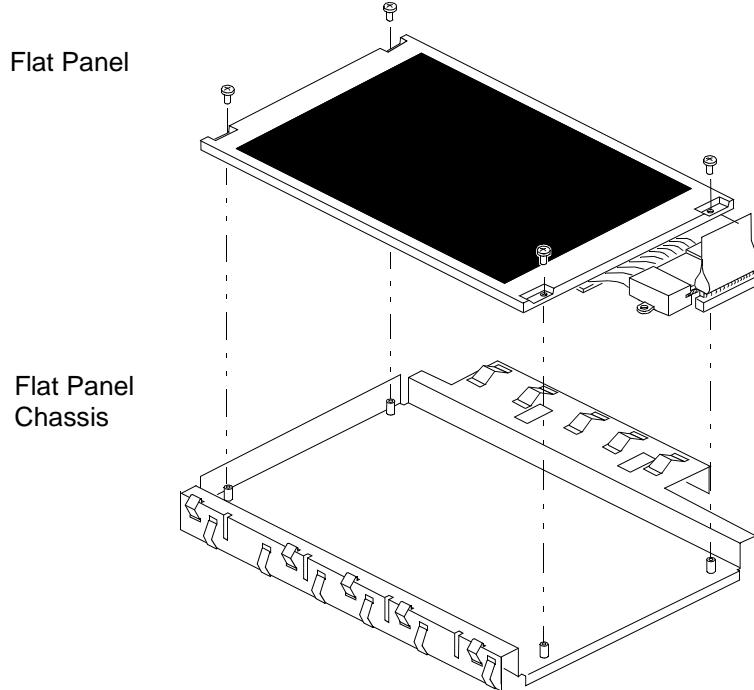


- 6 Slide the backlight cover back and down and push down on 2 tabs to secure the cover.
- 7 Using a jeweler size Phillips screwdriver, replace the 2 screws to secure the backlight cover housing the backlight and 2 backlight wires.



## Replacing the Flat Panel

- 1 Insert the Flat Panel (Display side up) into the Flat Panel Bracket and replace 4 screws securing the Flat Panel to the Flat Panel Bracket.



- 2 Grasping carefully by the sides, turn the Flat Panel over and place it (Display side down) into the Front Housing Assembly (with Antiglare screen).

---

**NOTE**

If the Flat Panel is being replaced, remove the ribbon cable with ferrite block from the Flat Panel and move it to the replacement Flat Panel. The (4) connectors to the Flat Panel are keyed and can be carefully removed with a small flat-bladed screwdriver.

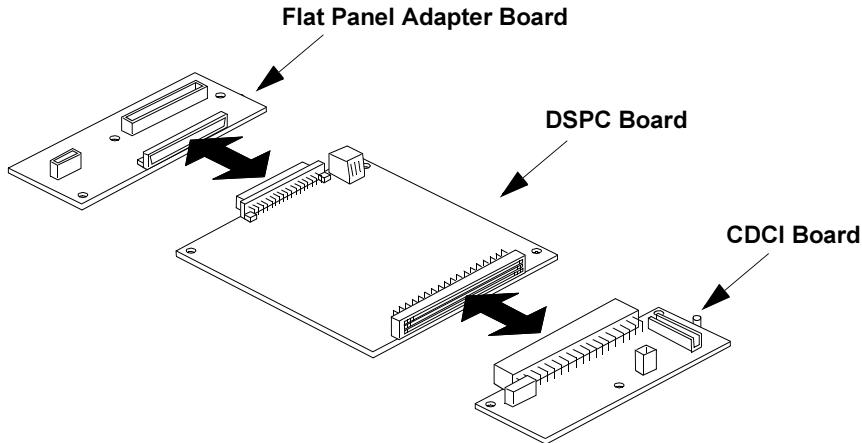
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**CAUTION**

FINGERPRINTS AND DIRT BETWEEN THE FLAT PANEL DISPLAY AND PLASTIC ANTIGLARE SCREEN SHOW UP PROMINENTLY DURING INSTRUMENT OPERATION. TAKE CARE NOT TO TOUCH THE FRONT OF THE FLAT PANEL SCREEN OR THE INSIDE OF THE CLEAR PLASTIC ANTIGLARE SCREEN. REMOVE ANY FINGERPRINTS OR DIRT USING A NON-RESIDUE-FORMING CLEANER (SUCH AS ALCOHOL) AND A LINT-FREE CLOTH.

## Replacing the 3-Board Assembly

- 1** Reassemble the 3 boards after replacing any individual boards. To form a complete board assembly, grip either the CDCI Board or the Flat Panel Adapter Board securely and gently push so that the board connector connects to the middle DSPC board.



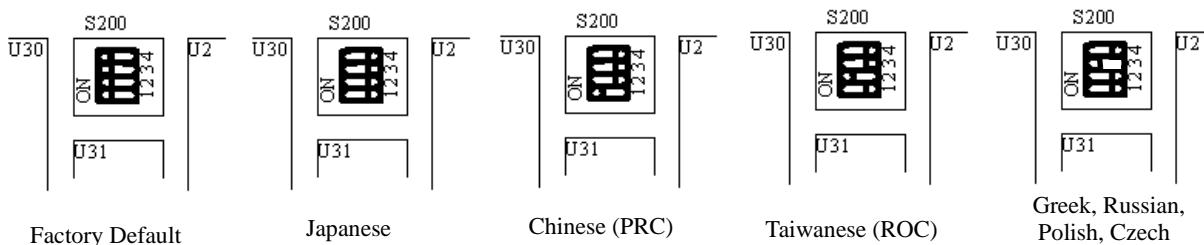

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**NOTE**


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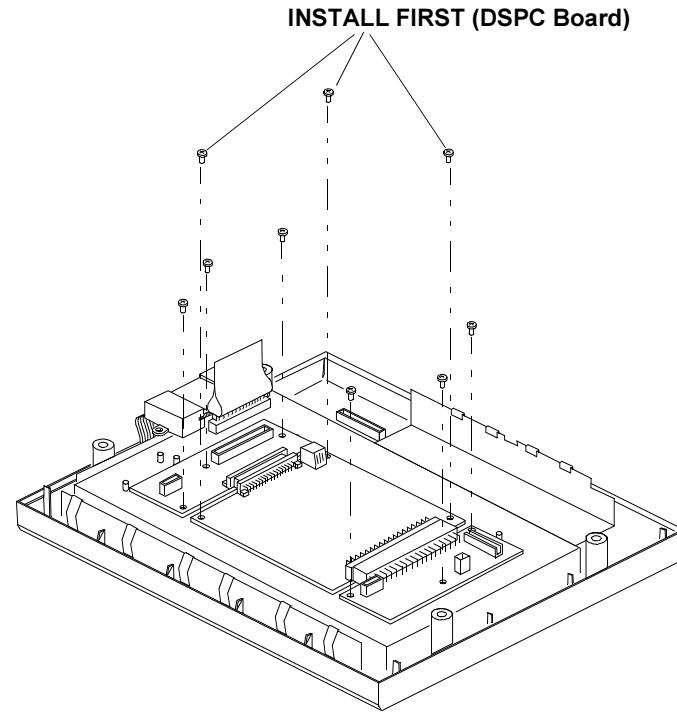
The following process for installing the board assembly adheres to an order of precedence. The middle DSPC board should be secured with screws first, followed by either of the other two end boards due to tolerance of the holes.

- 2** Replace the 3-Board assembly by:
- Placing the entire 3-Board assembly on the Flat Panel Bracket.
  - Screwing in the 3 screws securing the middle DPSC board to the Flat Panel Bracket.
  - Screwing in the six screws securing the CDCI Board and the Flat Panel Adapter Board to the Flat Panel Bracket.
- 3** If you are replacing the DSPC Board with Asian/Eastern Europe language option fitted, you need to set the DIP switches on the function card to select the correct language:

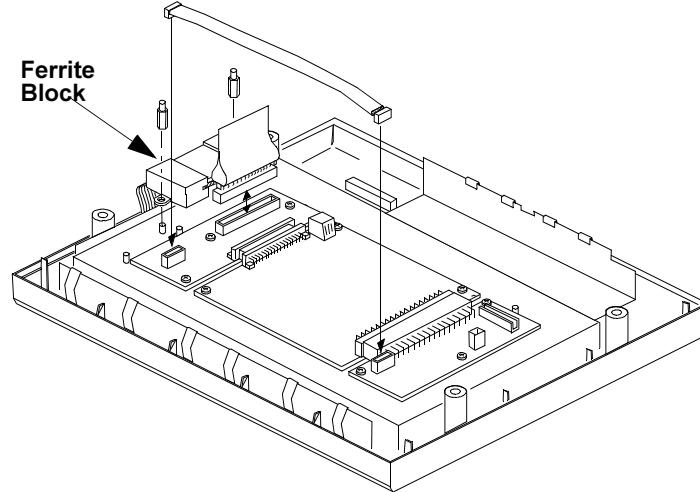


Language	DIP Switch Settings			
	1	2	3	4
Factory Default <sup>a</sup>	closed	closed	closed	closed
Japanese	open	open	open	open
Chinese (PRC)	closed	open	open	open
Taiwanese (ROC)	open	closed	open	open
Greek, Russian, Polish, Czech	open	open	closed	open

a. supports all languages except Japanese, Chinese (PRC), Taiwanese (ROC), Greek, Polish, Russian and Czech



- 4 Plug in the 12V cable connecting the CDCI Board to the Flat Panel Adapter Board.



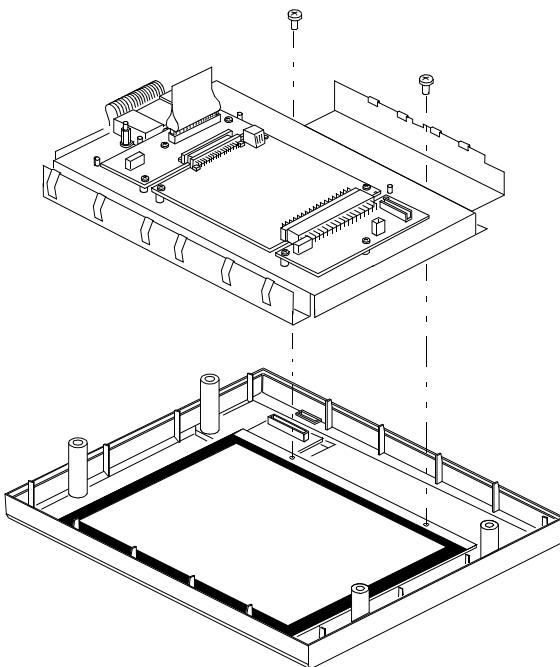
- 5 Plug the Flat Panel cable into the Flat Panel Adapter Board and secure the ferrite block with the 2 hex stand-off nuts.

## Replacing the Flat Panel Display Assembly

### CAUTION

Fingerprints and dirt between the Flat Panel Display and plastic antiglare screen show up prominently during instrument operation. Take care not to touch the Flat Panel screen or the inside of the clear plastic antiglare screen. Remove any fingerprints or dirt using a non-residue-forming cleaner (such as alcohol) and a lint-free cloth.

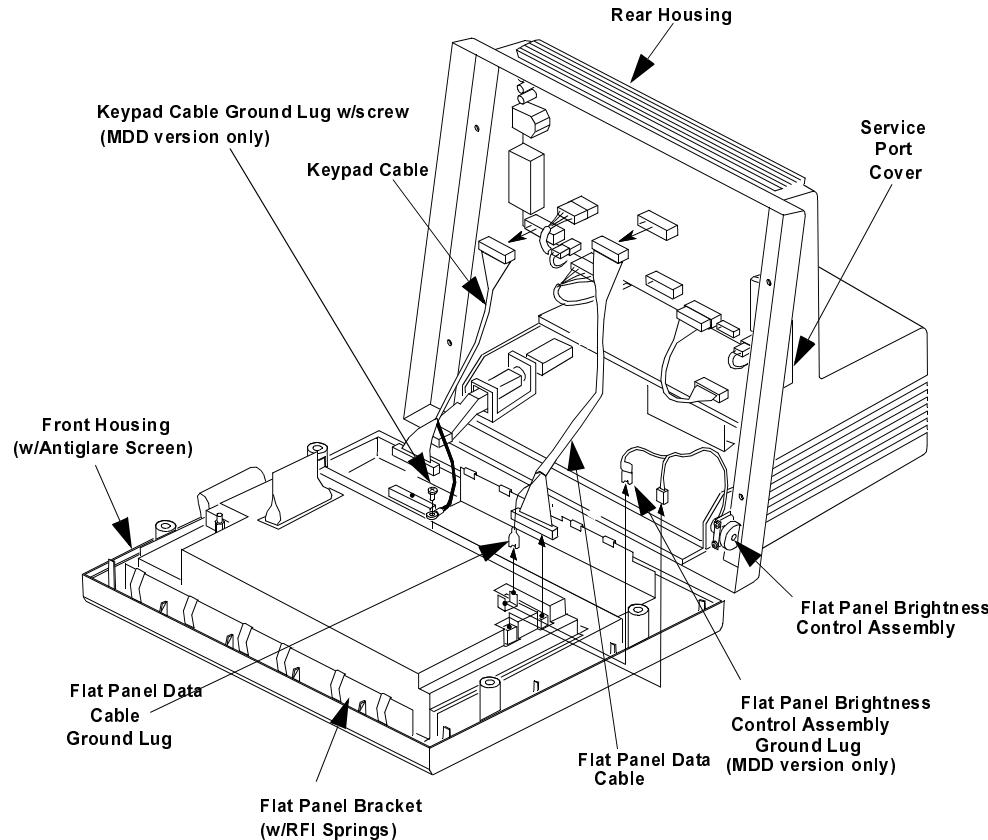
- 1 Verify power to the monitor is OFF and that the AC power cord is disconnected.
- 2 If it is a CT model, verify that the Lead-Acid batteries have been removed.
- 3 If not already completed, insert the Flat Panel Bracket containing the Flat Panel into the Front Housing (with antiglare screen).



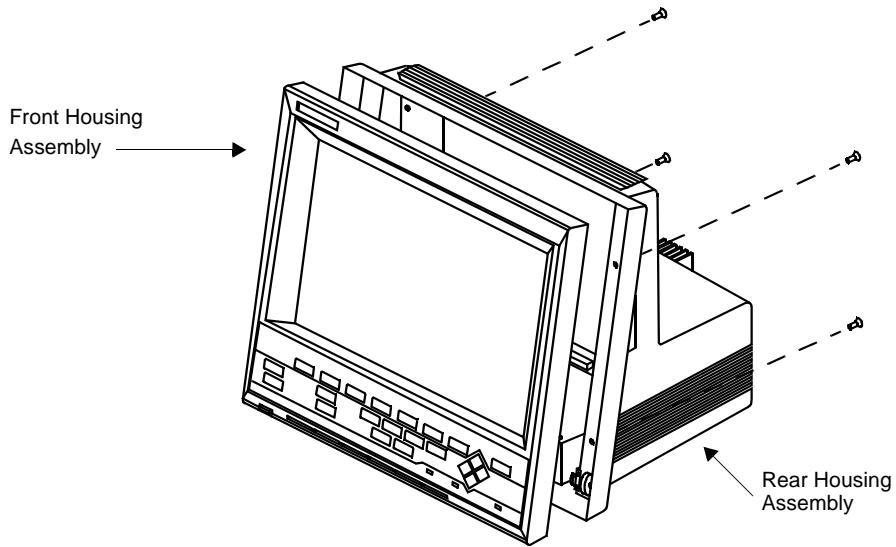
- 4 Screw in the screw securing the Flat Panel Bracket to the Front Housing.
- 5 If the Board Shield is already installed, install the 2 hex stand-off screws securing it and the Flat Panel Bracket to the top of the Front Housing. Otherwise, proceed to "Replacing the Board Shield."
- 6 Install the Front Housing Assembly.

## Replacing the Front Housing Assembly

- 1 Connect the Brightness Control Assembly to the CDCI Board (and ground lug for the MDD version of the instrument).
- 2 Connect the Flat Panel Data cable from the System Board to the CDCI Board (and ground lug).
- 3 Connect the Keypad cable to the Keypad (and ground lug for the MDD version of the instrument).
- 4 Make sure all other cables are connected correctly.



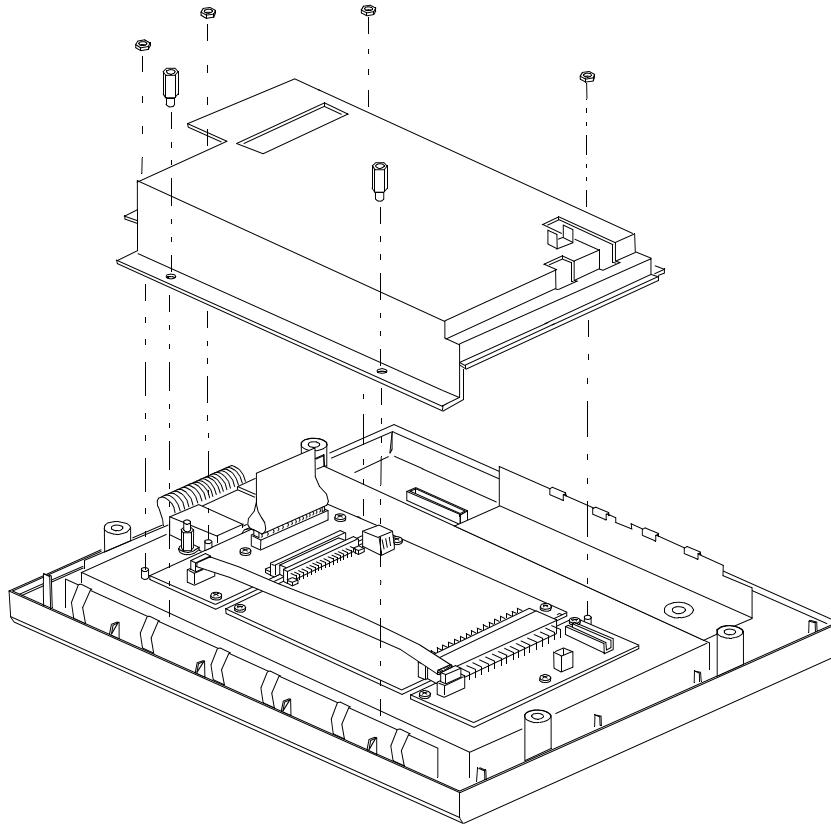
- 5** Attach the Front Housing Assembly to the Rear Housing. Replace the 4 screws at the rear of the Front Housing Assembly.



- 6** Connect the Local Distribution Cable, AC power cable, Plug-in Satellite Rack cable, Defib sync cable, and RS232 cable (where appropriate).

## Replacing the Board Shield

- 1 Place the Board Shield on the Flat Panel Bracket.
- 2 Screw in the 2 hex stand-off screws (5mm) located in the narrow channel securing the Board Shield and Flat Panel Bracket to the top of the Front Housing.
- 3 Screw on the 4 hex nuts (5.5mm) securing the rest of the Board Shield to the Flat Panel Bracket.



## Replacing Parameter Module Rack Assembly (M1276-60001)

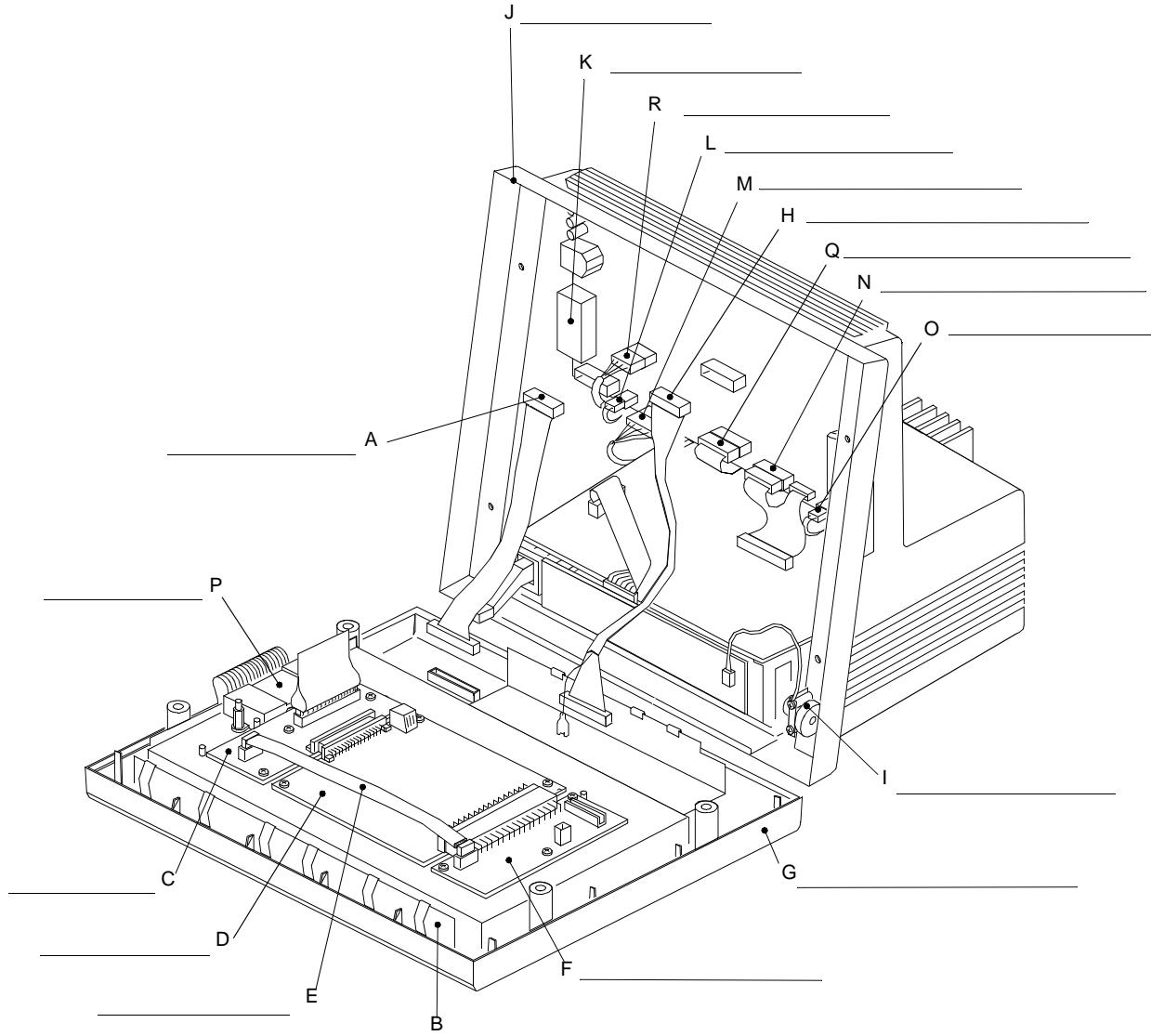
- 1 Align the slides on the Front End Rack Assembly with the mating slides on the monitor.
- 2 Slide the Front End Rack Assembly downward until it snaps into place.
- 3 Parameter modules can now be inserted into the parameter module rack assembly by sliding them into the rack until they snap into place.

## Replacing Lead-Acid Batteries (CT model)

- 1 Remove power to the instrument by pressing the power switch to OFF and disconnecting the AC power cord.
- 2 At rear of the instrument, open battery door (swings downward).
- 3 Slide lead-acid battery into chamber until it snaps into place. Repeat for other battery if necessary.

## Practice Exercise

To check your understanding, please complete the following exercise. Write the name of each assembly in the space provided which correspond to each letter shown in the illustration. After naming each replaceable assembly, check your answer with the answers provided on the following page.



## **Practice Exercise Answers**

- A. Keypad Cable
- B. Flat Panel Bracket
- C. Flat Panel Adapter Board
- D. DSPC Board
- E. 12v Cable
- F. CDCI Board
- G. Front Housing
- H. Flat Panel Data Cable
- I. Flat Panel Brightness Control Assembly
- J. Rear Housing
- K. Front End Link Cable Connector
- L. 60v Cable
- M. RS232 Cable
- N. 5v/12v Power Supply Cable
- O. Speaker Cable.
- P. Flat Panel Cable (w/ferrite block)
- Q. Docking Connector Cable
- R. SDN Cable

# Chapter 10 Removing & Replacing Plug-in Modules

## Objective

After reading this chapter you will be able to **remove** and **replace** the Agilent V24/V26 Series Plug-in Modules listed in the following table.

## In this chapter

The removal and replacement procedures for the Plug-in Modules are easy to complete when following the step-by-step procedures outlined in this chapter.

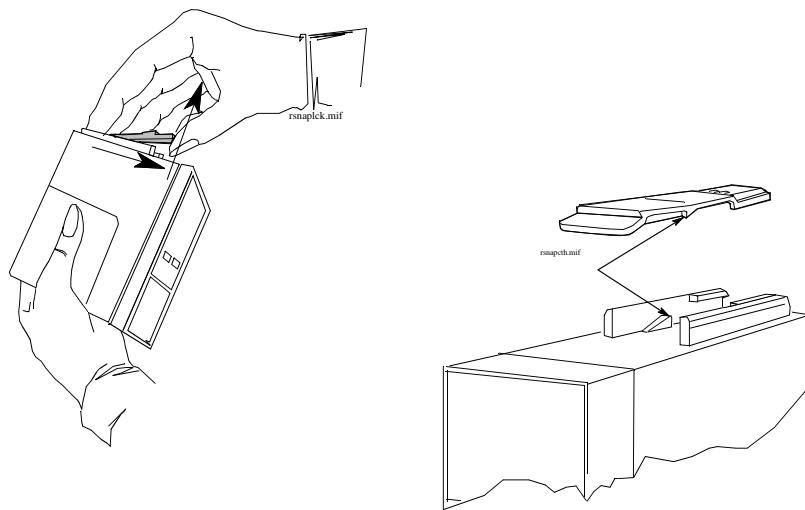
### Replaceable Parts for Plug-in Modules

The following is a list of replaceable parts for the plug-in modules.

Replaceable Parts	Page
Snap Lock	9-2
Plug-In Module Removal	9-3
NBP Inlet Connector Insert	9-5
NBP Pump	9-6
tcpO2/tcpCO2 Calibration Chamber Kit	9-7
Recorder Module Paper	9-8

*The snap lock  
holds the plug-in  
module in the  
satellite rack.*

## Snap Lock



### To Remove the Snap Lock

- Step 1** Grip the module firmly in one hand and using your thumb, pull the front edge of the snap lock away from the plug-in module so that the lug on the snap lock clears the retaining edge of the module.
- Step 2** Push on the rear edge of the snap lock to move the snap lock through the slot toward the front of the module until it is clear.

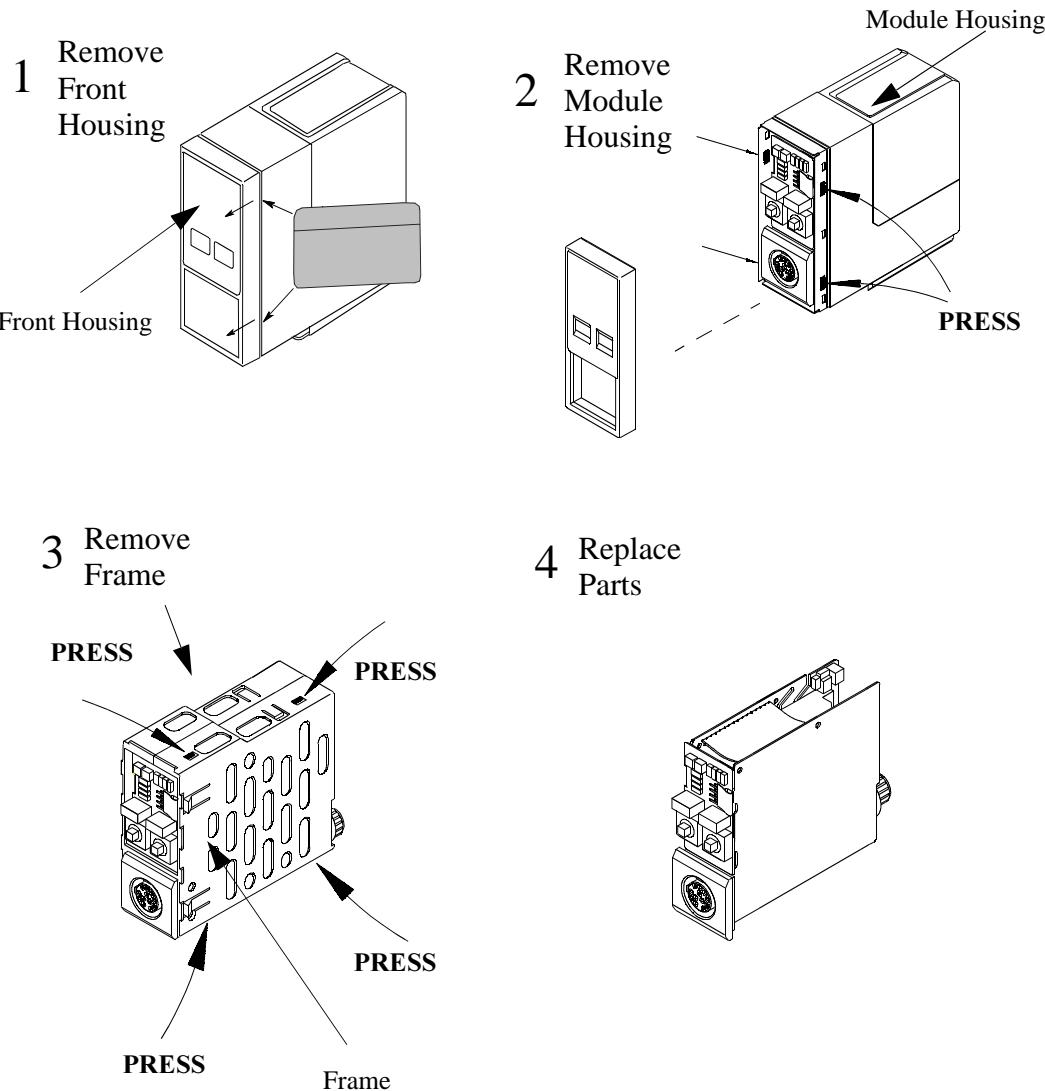
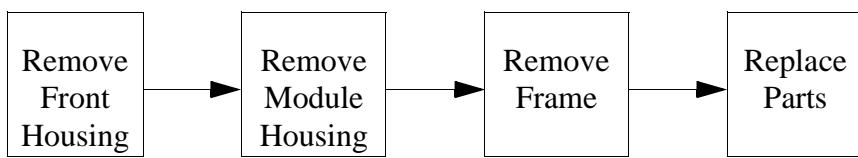
### To Replace the Snap lock

- Step 1** Locate the snap lock into the slot on the bottom of the module.
- Step 2** Slide the snap lock toward the rear of the module until the lock snaps into position.

*Removal of the parameter module enables replacement of the front assembly, overlay, middle frame, LEDs, switches and connectors.*

## Plug-In Module Removal

The work-flow for plug-in module removal is as follows.



### To Remove a Plug-In Module

**Step 1** Remove the Front Housing.

- a. Place the module on a flat surface and insert a card (similar to a credit or cheque type card) into one side of the module to disengage the 2 tabs securing the front housing to the module housing.
- b. Pull the edge of the front housing away from the module housing.
- c. Carefully turn the module over so the free edge does not reengage and repeat steps a) and b) on the other side of the module. The front housing should now be free of the module housing.

**Step 2** Press the 4 tabs on the front rim of the module housing and remove the module housing from the internal frame and PCB.

**Step 3** Press the 2 tabs on the top and 2 tabs on the bottom of the frame and pull the frame clear of the PCB.

**Step 4** Replace the appropriate connector, switches and LEDs on the module.

### To Replace a Plug-in Module

**Step 1** Seat the connectors and PCBs into position in the frame.

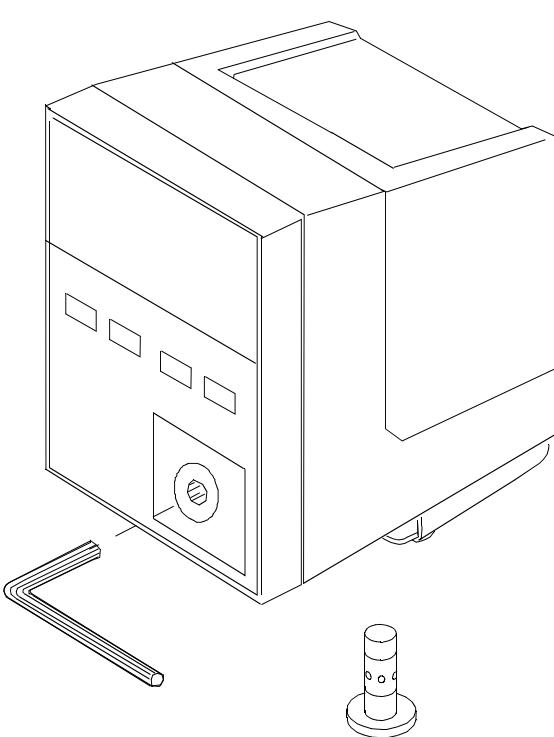
**Step 2** Carefully snap-lock the frame together with the module PCB inside.

**Step 3** Re-insert and snap-fit the frame into the module case so the front and rear connectors align with the module case.

**Step 4** Snap-fit the front housing onto the front of the module case so the openings in the front housing match the LEDs and keys.

## NBP Inlet Connector Insert

The NBP Inlet Connector is replaced without opening the module. Do not remove the transparent cover on the connector.



### To Remove the NBP Inlet Connector Insert

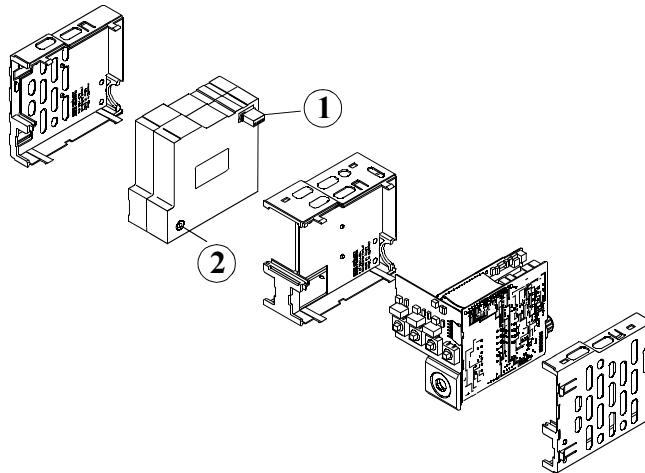
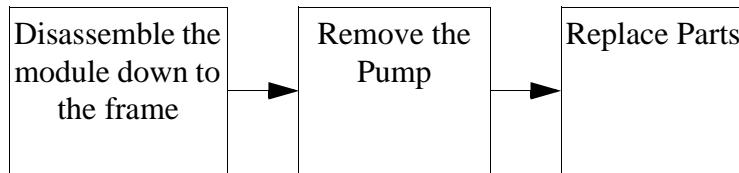
- Step 1** Use a 6mm Allen key to unscrew the defective connector insert from the inlet of the NBP module.
- Step 2** Verify that the connector insert contains 4 metal balls in the transparent cover. If a ball is missing, it may have fallen into the module tubing. Damage could result necessitating exchange of the module.

### To Replace the NBP Connector Insert

- Step 1** Using a torque wrench, screw the replacement connector insert into the NBP module, applying a torque of 10 Ncm (14 oz inches).
- Step 2** Perform the NBP module specification test as described in this manual.

The NBP pump  
inflates the  
pressure cuff

## NBP Pump



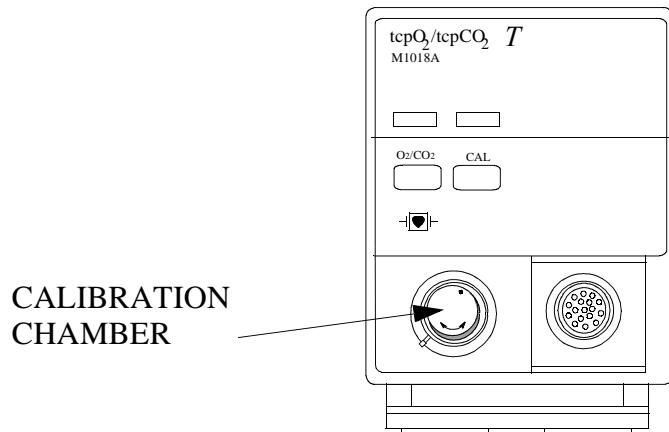
### To Remove the NBP Pump

- Step 1** Using a small screwdriver or similar tool, unplug the white 4-pin connector from the socket through the access hole on the top rear module casing.
- Step 2** Grip and pull the red pump block assembly from the air inlet connector and the module assembly.

### To Replace the NBP Pump

- Step 1** Remove the protective cap from the air inlet connector on the pump module.
- Step 2** Facing the front of the module, locate the pump assembly into the left side of the module assembly. Ensure the air inlet tube fits properly into the air inlet connector of the pump.
- Step 3** Using a small screwdriver or similar tool, plug the white 4-pin connector into the socket on the module assembly. To gain access to the connector, carefully lift the PCB on the opposing side of the module assembly.
- Step 4** Once the pump is in place, locate the PCB into its original position and reassemble the module. Perform the NBP module specification test in this manual. Calibration is required if the test fails.

## tcpO<sub>2</sub>/tcpCO<sub>2</sub> Calibration Chamber Kit



### To Remove the Calibration Chamber

- Step 1** Using a flat-tipped screwdriver, remove the screw holding the calibration chamber in place on the front of the plug-in module.
- Step 2** Lift the chamber off the plug-in module. Ensure that the white plastic switch tip located in the module is not lost.

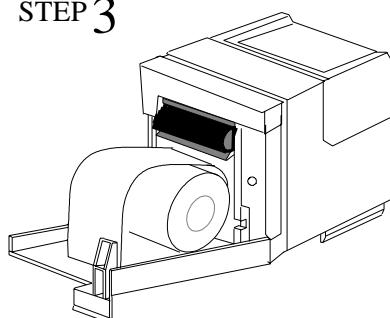
### To Replace the Calibration Chamber

- Step 1** Ensure the white plastic switch tip is in place in the plug-in module.
- Step 2** Place the calibration chamber in the allocated position on the plug-in module.
- Step 3** Insert and tighten the screw into the calibration chamber, securing it to the plug-in module.

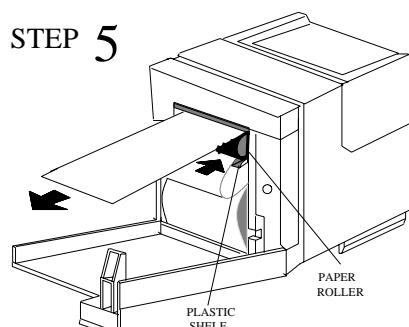
## Recorder Module Paper

The recorder will not run when the door is open or when the recorder is out of paper. To prevent damage to the recorder module, use only Agilent approved paper (Agilent re-order number 40477A/B)

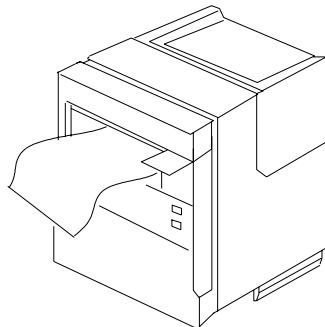
STEP 3



STEP 5



STEP 6



### To Load Paper into the Recorder Module

**Step 1** Remove the empty core from the previous roll of paper.

**Step 2** Cut off and discard the first few inches of paper to eliminate any traces of adhesive.

**Step 3** Pull out several inches of paper from the new roll, holding the roll with the loose end hanging over the top toward you.

**Step 4** Open the door and push the paper roll into the holders in the recorder.

**Step 5** Thread the paper under the roller and over the plastic shelf far enough so it goes around the roller and comes out above it.

**Step 6** Drape the paper over the end of the door and close the door. The paper should be visible and draped down in front of the door.

# Chapter 11 Replacement Parts

## Objective

After reading this chapter, you will be able to identify the replaceable components and know which subassemblies you can order for the instrument.

## In this chapter

The instrument is comprised of several components which may be exchanged or replaced if they break. This chapter provides you with exploded views and replacement part numbers for all of the field replaceable components of the V24/V26 Series.

The circuit boards used in the V24/V26 Series contain Surface Mounted Devices (SMD) which can only be repaired with special equipment, not available in the field. For this reason, the majority of the parts used in the system can only be replaced at board level.

Contact your local Agilent Response Center for information on how to order parts.

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**NOTE**

If your service strategy includes the Agilent five year warranty repair program, refer to the *User Guide for Agilent Warranty Repair Service* for details.

Topics in this chapter	See Page
<b>Product Identification</b>	<b>11-3</b>
<b>Model V24 Field Replaceable Parts</b>	<b>11-4</b>
<b>Model V24C/V26C Field Replaceable Parts</b>	<b>11-9</b>
<b>Model V24CT/V26CT Field Replaceable Parts</b>	<b>11-16</b>
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Sidestream CO <sub>2</sub> Module Accessories	11-38
SpO <sub>2</sub> Module Accessories	11-38
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Thermal Array Recorder Module Accessories	11-39
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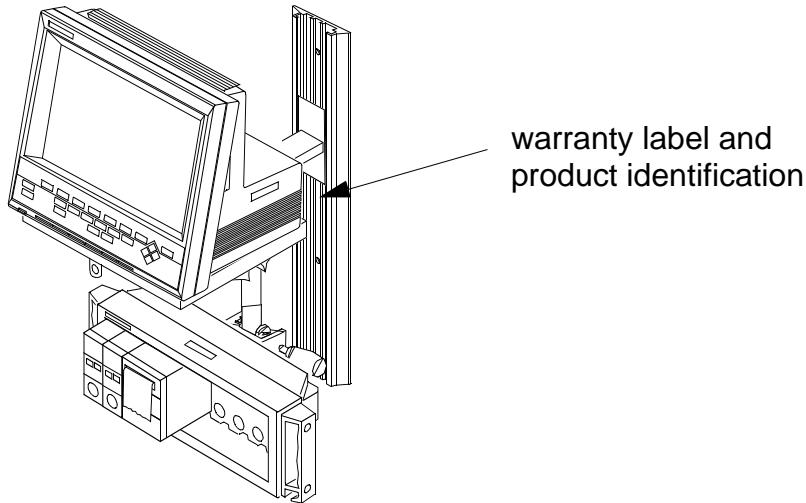
## Product Identification

The Agilent V24/V26 Series monitor comes in the following versions:

- One monochrome version (Model V24 option 020)
- Five color versions
  - MDD version (Model V24C/V26C option 022)
  - Standard version (Model V24C/V26C option 021)
  - Asian Version (Model V24C/V26C option 023)
  - Standard, new display, MDD-compatible (Model V24C/V26C option 026)
  - Standard and Asian, new display (Model V24C/V26C option 027)
- Four battery color versions
  - Standard version (Model V24CT/V26CT option 024)
  - Asian version (Model V24CT/V26CT option 025)
  - Standard and Asian, new display (Model V24CT/V26CT option 028)
  - Standard, new display (Model V24CT/V26CT option 029)

To differentiate, observe the model option string on the serial number label typically located on the instrument mainframe's right side.

The right side rear of the instrument has a warranty identification label that provides warranty information. The instrument also has a product identification label that lists product name, product number and serial number. When identifying the product (for example to a Response Center), you require only the product number and serial number.



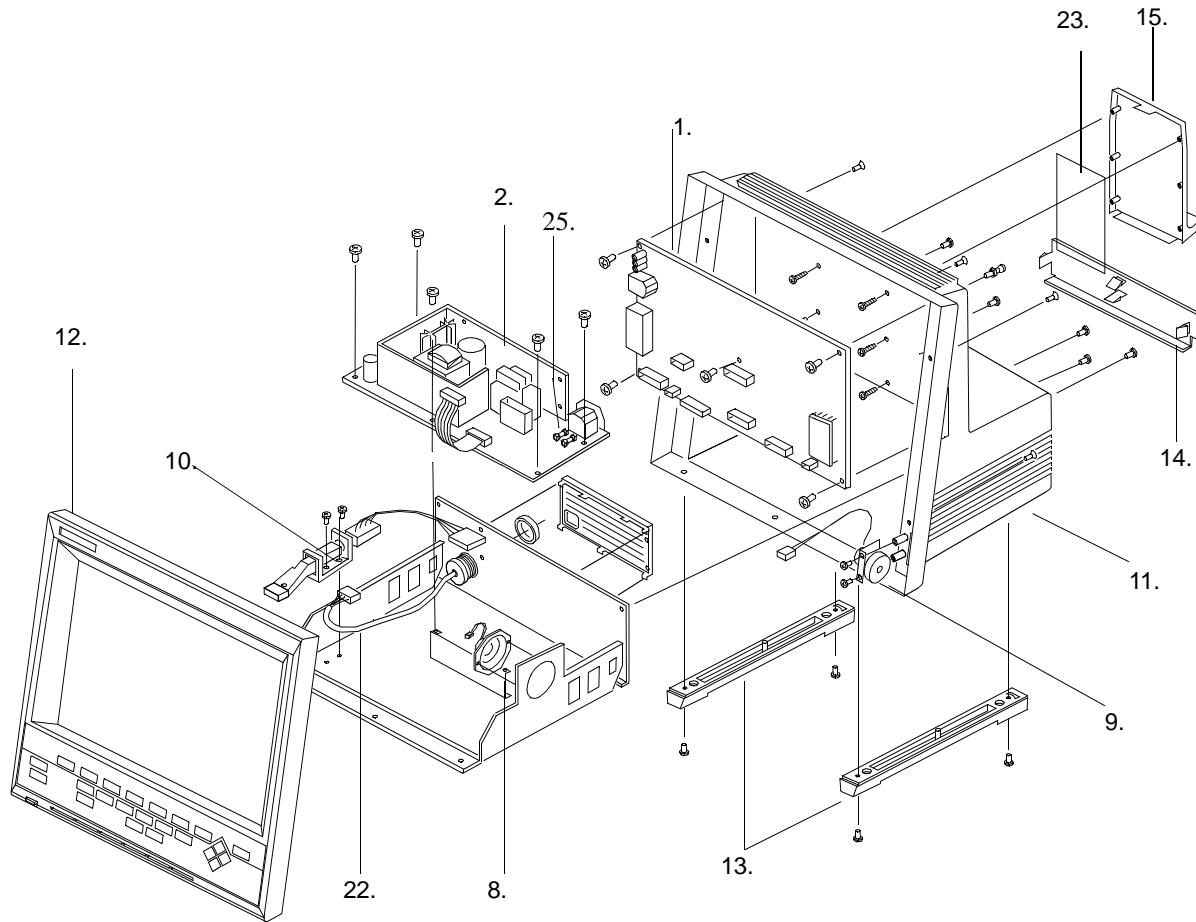
To help you identify the correct parts of your front housing version, refer to the following table:

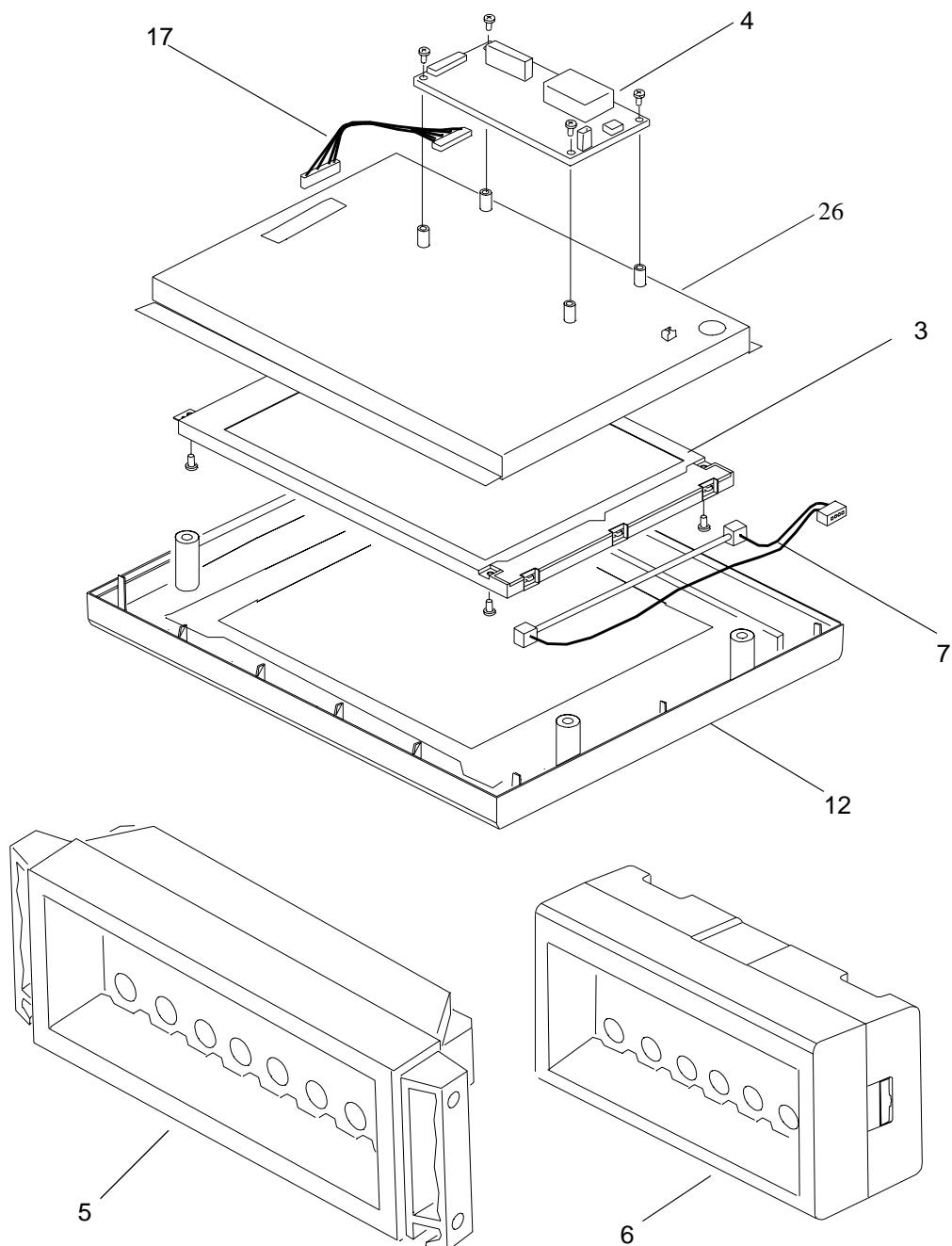
Option	Prefix Date Code	Version
021 to 025	—	<b>1</b>
J90	3931 or greater	
026 to 029	Less than 3927	<b>2</b>
027 and 028	3927 or greater	<b>3</b>
027 and 028	3931 or greater	<b>4</b>

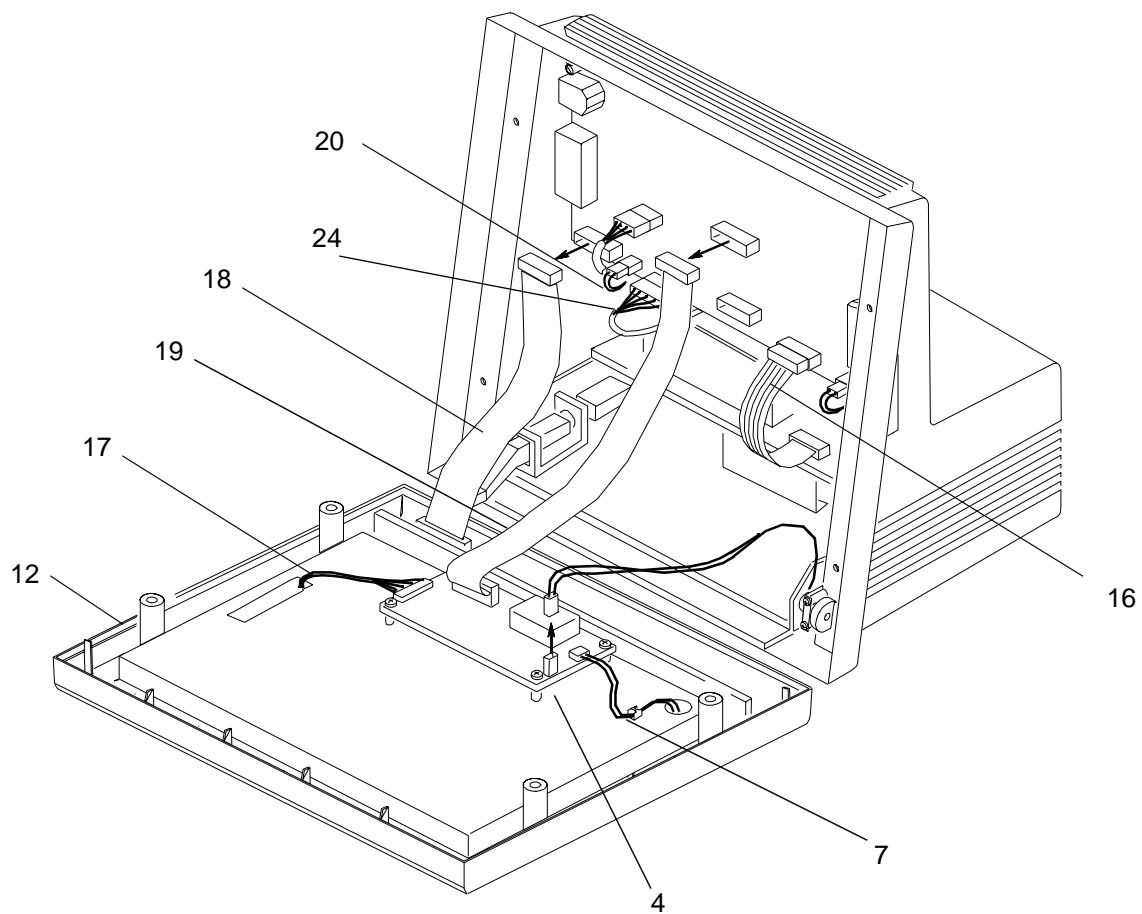
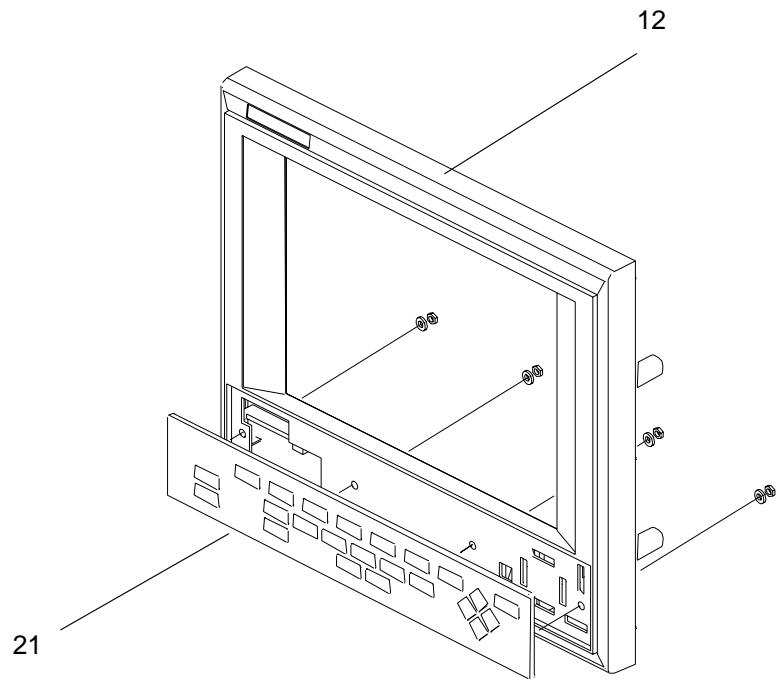
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**Model V24 Field Replaceable Parts  
(Monochrome Mainframe)**

Replacement Parts







**Table 11-1. Model V24 Replaceable Parts - Agilent M1204A Monochrome Mainframe**

<b>Item</b>	<b>Exchange Part Number</b>	<b>New Part Number</b>	<b>Description</b>
1	M1204-68107 <sup>1</sup>	M1204-60107 <sup>1</sup>	System Board
	M1204-68107 <sup>1</sup>	M1204-66107 <sup>1</sup>	System Board
2		M1204-60060 M1204-63000	Power Supply Assembly
3		1990-1726	Flat Panel Display, Monochrome
4		M1204-60200	Flat Panel Adapter Board
5	M1041-68001 (old color) M1041-68101(new color)	M1041-60001 (old color) M1041-60101 (new color)	8 Slot Plug-In Rack
6	M1276-68001 (old color) M1276-68002 (new color)	M1276-60001 (old color) M1276-60003 (new color)	6 Slot Plug-In Rack
7		1990-1911	Flat Panel Backlight Tube Assembly
8		M1204-61025	Speaker Assembly
9		M1204-61020	Flat Panel Contrast Control Assembly
10		M1204-60194	Power Switch Assembly
11		M1204-67000 (old color) M1204-67002 (old color) M1204-67902 (new color)	Rear Housing Kit (serial prefix < 3608) Rear Housing Kit (serial prefix > = 3608) Rear Housing Kit (serial prefix >3608)
12		M1204-67001 (old color) M1204-67901 (new color)	Front Housing Kit with Antiglare Screen <sup>2</sup>
13		M1275-40010 (old color) M1204-40910 (new color)	Monitor Foot
14		M1204-41010 (old color) M1204-41910 (new color)	Rear Housing Cover, Lower
15		M1204-41040 (old color) M1204-41940 (new color)	Rear Housing Cover, Upper
16		M1204-60150	Cable, 5V/12V Power Supply to System Board
17		M1204-60160	Cable, Flat Panel to Flat Panel Adapter Board
18		M1275-60170	Cable, Keypad to System Board
19		M1204-60180	Cable, Flat Panel Data
20		M1204-60190	Cable, 60V, Power Supply to System Board
21		M1204-60041 (old color) M1204-60941(new color)	Keypad, English
21		M1204-60042 (old color) M1204-60942 (new color)	Keypad, French
21		M1204-60043 (old color) M1204-60943 (new color)	Keypad, German
21		M1204-60044 (old color) M1204-60944 (new color)	Keypad, Dutch
21		M1204-60045 (old color) M1204-60945 (new color)	Keypad, Spanish
21		M1204-60046 (old color) M1204-60946 (new color)	Keypad, Italian
21		M1204-60047 (old color) M1204-60947 (new color)	Keypad, Swedish
21		M1204-60048 (old color) M1204-60948 (new color)	Keypad, Finnish

**Table 11-1. Model V24 Replaceable Parts - Agilent M1204A Monochrome Mainframe**

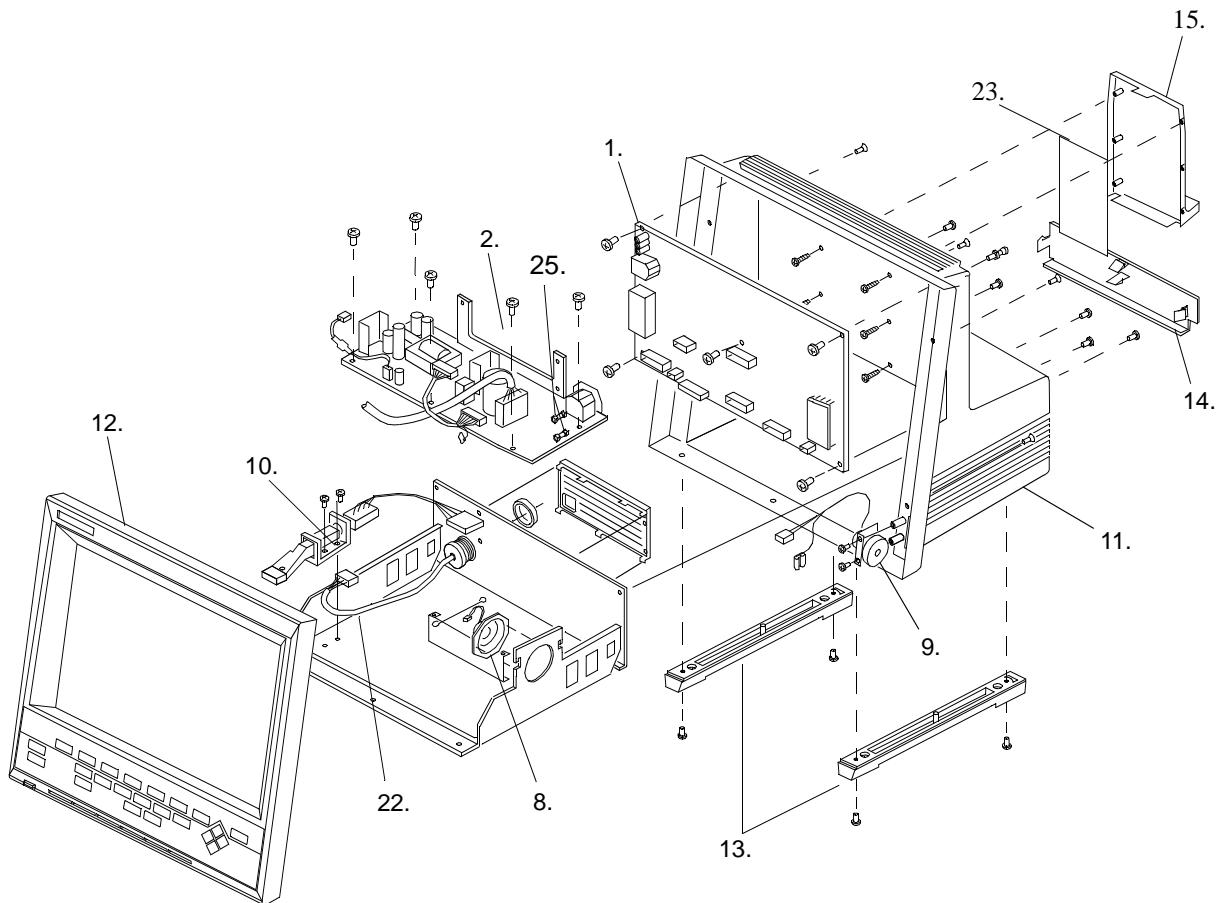
<b>Item</b>	<b>Exchange Part Number</b>	<b>New Part Number</b>	<b>Description</b>
21		M1204-60049 (old color) M1204-60949 (new color)	Keypad, Norwegian
21		M1204-60050 (old color) M1204-60950 (new color)	Keypad, Danish
21		M1204-60051 (old color) M1204-60951 (new color)	Keypad, Japanese
21		M1204-60052 (old color) M1204-60952 (new color)	Keypad, Traditional Chinese
21		M1204-60053 (old color) M1204-60953 (new color)	Keypad, Simplified Chinese
21		M1204-60854	Keypad, Portuguese
21		M1204-60955	Keypad, Greek
21		M1204-60957	Keypad, Russian
21		M1204-60960	Keypad, Polish
21		M1204-60958	Keypad, Czech
22		M1204-60140	SDN Connector Assembly
23		M1204-41030	Rear Housing Cover Seal, Upper
24		M1204-60130	Internal RS232 Cable
		M1204-60192	RS232 Cable (Printer)
		0403-0776	Bumper Snap-in
		1818-5130	EEPROM IC (150ns)
		M1275-40089 (old color) M1204-40989 (new color)	Service Port Cover
		M1275-61055 (old color) M1204-61955 (new color)	Handle Assembly
25		2110-0633	Fuse (F1, F2) 2.5A/250V
26		M1204-01005	Flat Panel Bracket

<sup>1</sup> M1204-60107 (only fits monochrome mainframe s/n > = 3608); M1204-66107, -68107 (fits any monochrome mainframe; also replaces M1204-6x100 System Board). For older monochrome instruments with SDN Daughter Board configuration, See Appendix A.

<sup>2</sup> Front Housing Kit does not include Flat Panel.

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## Model V24C/V26C Field Replaceable Parts (Color Mainframe)



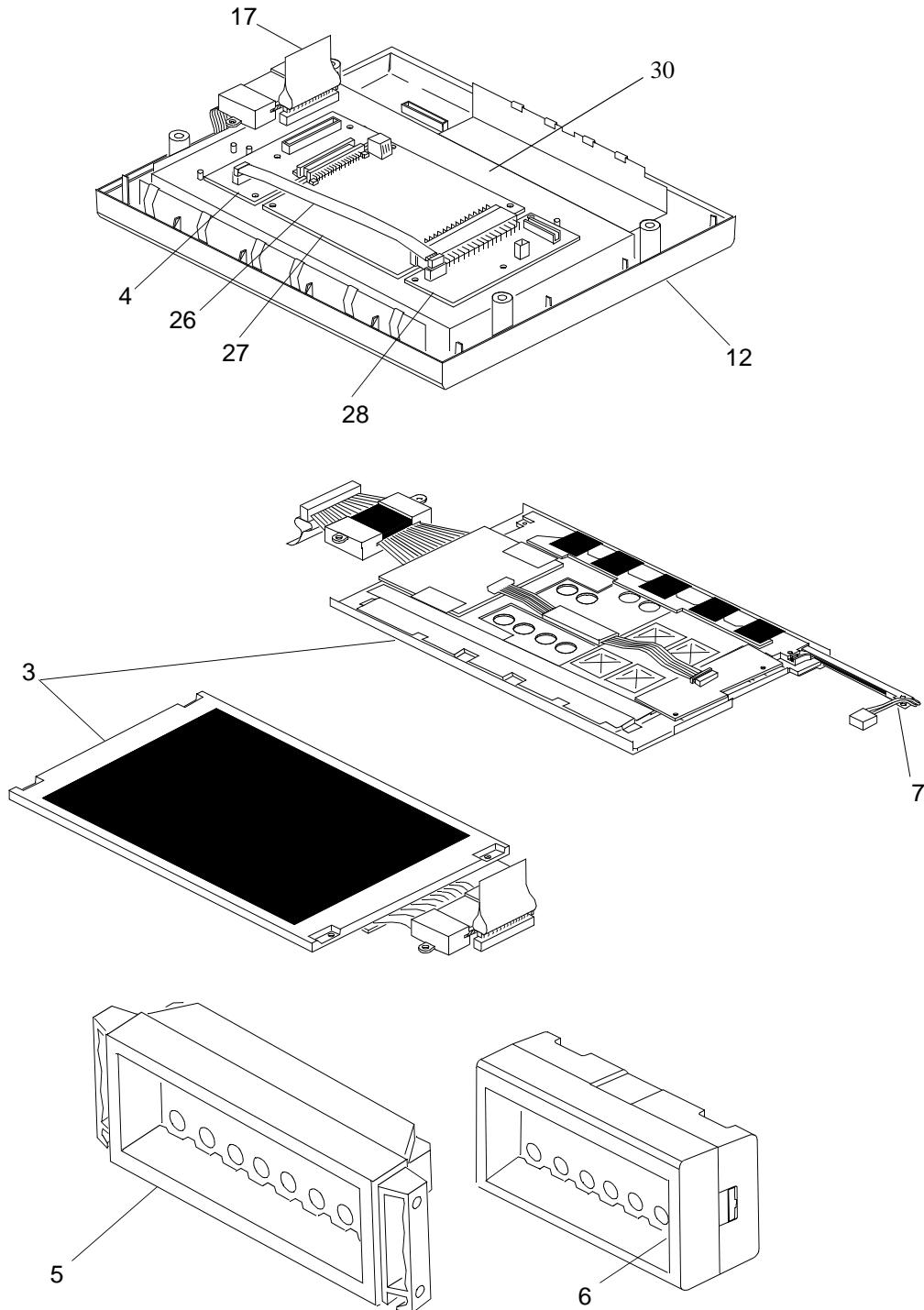
Replacement Parts

The Agilent V24C/V26C and V24CT/V26CT Models exist with 4 different front housing assembly versions. To help you identify the correct parts for your front housing version, refer to the following table:

Option	Prefix Date Code	Version
021 to 025 J90	— 3931 or greater	1
026 to 029	Less than 3927	2
027 and 028	3927 or greater	3
027 and 028	3931 or greater	4

## **Version 1**

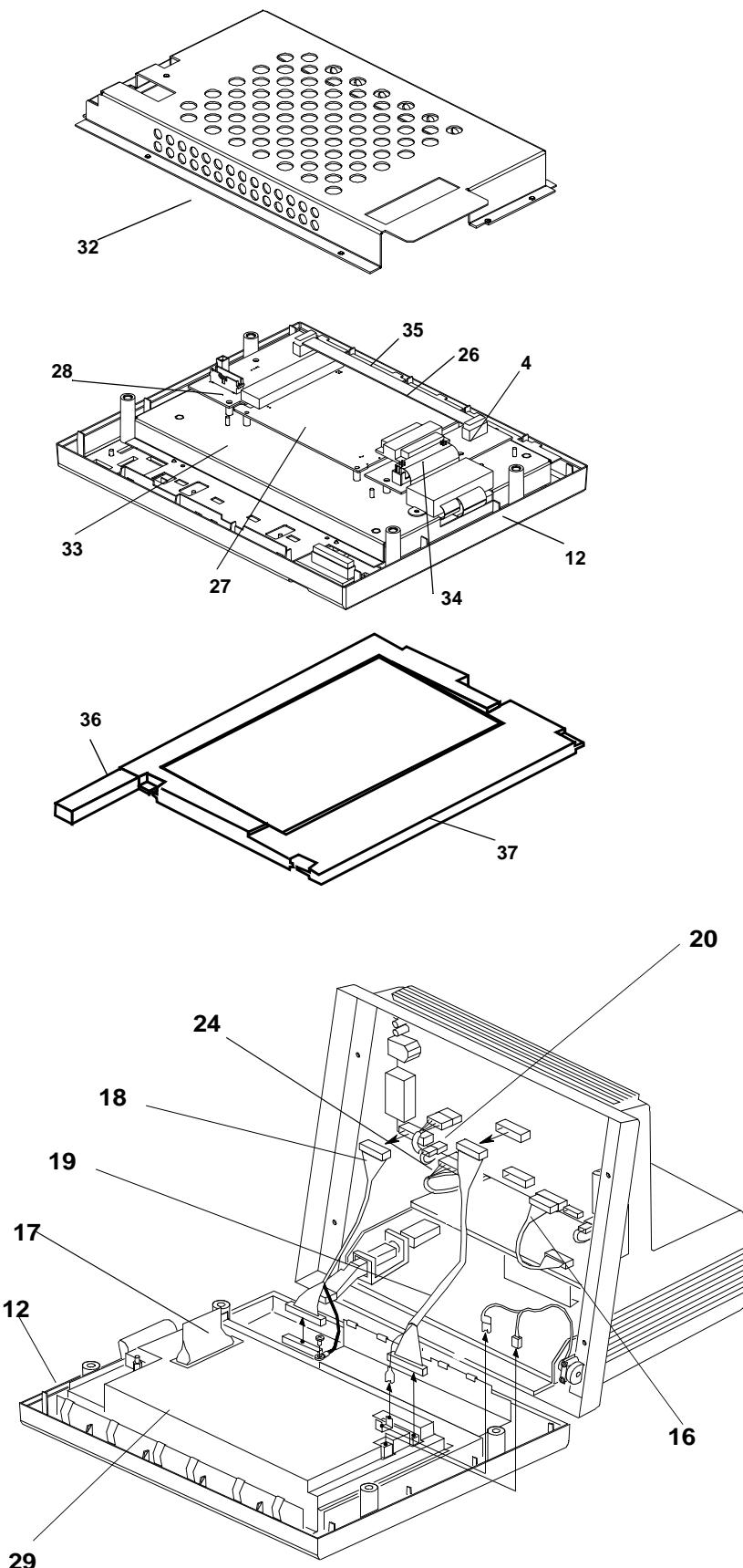
**Model V24C/V26C/V24CT/V26CT Field Replaceable Parts (Color Mainframe, Old display #021, #022, #023, #024, #025)**



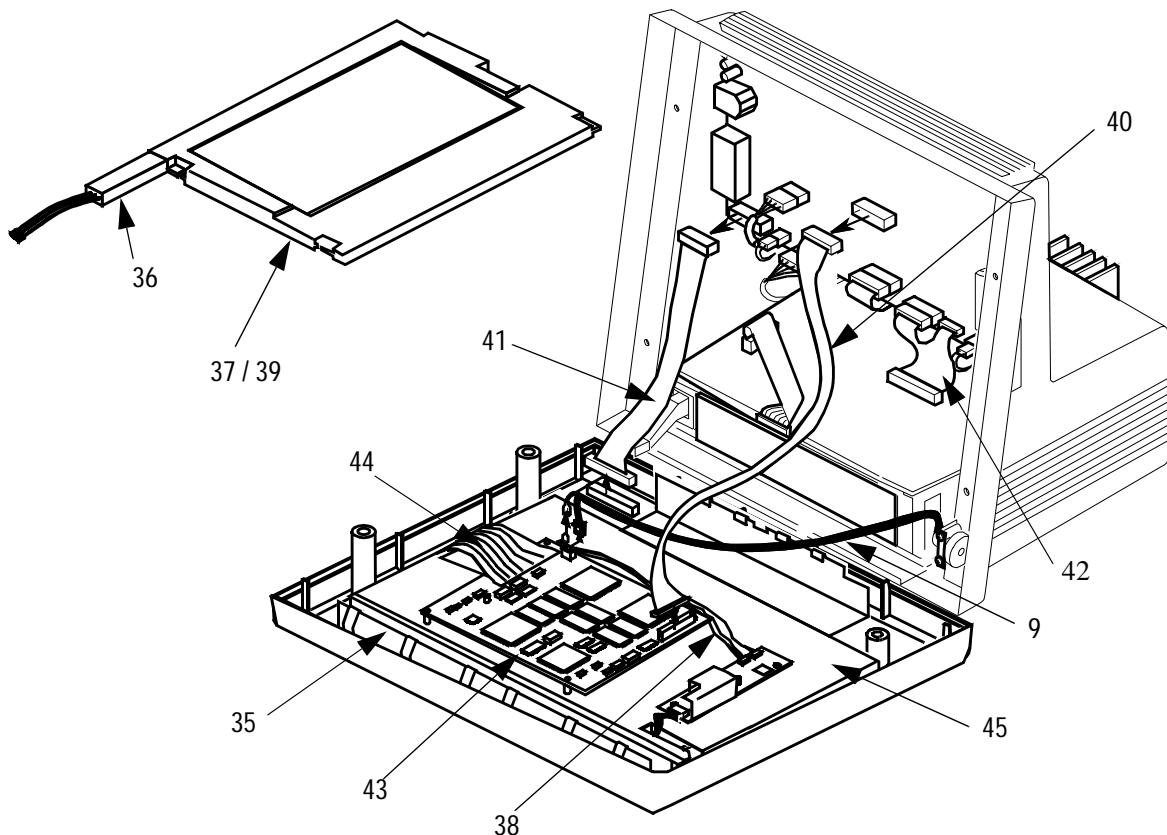
## Version 2

Model V24C/V26C/V24CT/V26CT Field Replaceable Parts (Color Mainframe, New display #026, #027, #028, #029)

Replacement Parts



**Version 3&4**



**Table 11-2 Model V24C/V26C Replaceable Parts - Agilent M1204A Color Mainframe***Note: If nothing is stated in the Version column the part applies for all versions*

<b>Item</b>	<b>Exchange Part Number</b>	<b>New Part Number</b>	<b>Description</b>	<b>Version</b>
1	M1204-68101	M1204-60101	System Board	
2		M1204-63000	Power Supply Assembly	
3		2090-0347	Flat Panel Display, Color	<b>1</b>
4		M1204-66201	Flat Panel Adapter Board	<b>1,2</b>
5	M1041-68001 (old color) M1041-68101(new color)	M1041-60001 (old color) M1041-60101 (new color)	8 Slot Plug-In Rack	
6	M1276-68001 (old color) M1276-68002 (new color)	M1276-60001 (old color) M1276-60003 (new color)	6 Slot Plug-In Rack	
7		2090-0546	Flat Panel Backlight Tube Assembly	<b>1</b>
8		M1204-61025	Speaker Assembly	
9		M1204-61108 (opt 022, 026, 027) M1204-61109 (opt 021, 023)	Flat Panel Brightness Control Assembly	
10		M1204-60194	Power Switch Assembly	
11		M1204-67002 (old color) M1204-67902 (new color)	Rear Housing Kit	
12		M1204-67003 <sup>1</sup> (opt. 022 old color) M1204-67903 <sup>1</sup> (opt. 022 new color) M1204-67006 <sup>1</sup> (opt. 021, 023 old color) M1204-67906 <sup>1</sup> (opt. 021, 023, 026, 027 new color)	Front Housing Kit with Antiglare Screen	
13		M1204-40010 (old color) M1204-40910 (new color)	Monitor Foot	
14		M1204-41010 (old color) M1204-41910 (new color)	Rear Housing Cover, Lower	
15		M1204-41040 (old color) M1204-41940 (new color)	Rear Housing Cover, Upper	
16		M1204-60077	Cable, 5V/12V Power Supply to System Board	
17		M1204-60055	Cable, Flat Panel to Flat Panel Adapter Board (with ferrite block)	<b>1</b>
18		M1204-60074 (opt.022) M1275-60170 (opt. 021, 023; 026; 027)	Cable, Keypad to System Board	
19		M1204-60076	Cable, Flat Panel Data	<b>1,2</b>
20		M1204-60072	Cable, 60V, Power Supply to System Board	
21		M1204-60041 (old color) M1204-60941 (new color)	Keypad, English	
21		M1204-60042 (old color) M1204-60942 (new color)	Keypad, French	
21		M1204-60043 (old color) M1204-60943 (new color)	Keypad, German	

**Table 11-2 Model V24C/V26C Replaceable Parts - Agilent M1204A Color Mainframe(*Continued*)**

<b>Item</b>	<b>Exchange Part Number</b>	<b>New Part Number</b>	<b>Description</b>	<b>Version</b>
21		M1204-60044 (old color) M1204-60944 (new color)	Keypad, Dutch	
21		M1204-60045 (old color) M1204-60945 (new color)	Keypad, Spanish	
21		M1204-60046 (old color) M1204-60946 (new color)	Keypad, Italian	
21		M1204-60047 (old color) M1204-60947 (new color)	Keypad, Swedish	
21		M1204-60048 (old color) M1204-60948 (new color)	Keypad, Finnish	
21		M1204-60049 (old color) M1204-60949 (new color)	Keypad, Norwegian	
21		M1204-60050 (old color) M1204-60950 (new color)	Keypad, Danish	
21		M1204-60051 (old color) M1204-60951 (new color)	Keypad, Japanese	
21		M1204-60052 (old color) M1204-60952 (new color)	Keypad, Traditional Chinese	
21		M1204-60053 (old color) M1204-60953 (new color)	Keypad, Simplified Chinese	
21		M1204-60854	Keypad, Portuguese	
21		M1204-60955	Keypad, Greek	
21		M1204-60957	Keypad, Russian	
21		M1204-60960	Keypad, Polish	
21		M1204-60958	Keypad, Czech	
22		M1204-60140	SDN Connector Assembly	
23		M1204-60080	Rear Housing Cover Seal, Upper	
24		M1204-60130	Internal RS232 Cable	
		M1204-60192	RS232 Cable (Printer)	
		0403-0776	Bumper Snap-in	
		1818-5130	EEPROM IC (150ns)	
		M1275-40089 (old color) M1204-40989 (new color)	Service Port Cover	
		M1275-61055 (old color) M1204-61955 (new color)	Handle Assembly	
		M1204-83014 <sup>2</sup>	Insulator	
		9170-1521 <sup>3</sup>	Core Shielding Bead	
25		2110-0792	Fuse (F1, F2) 2.0A/250V	
26		M1204-60070	Flat Panel Power Cable (12V)	<b>1,2</b>
27	M1074-68502	M1074-66502 <sup>5</sup>	DSPC_Flat Controller	<b>1,2</b>
27	M1074-68503	M1074-66503 <sup>5</sup>	DSPC Controller with Asian character sets <sup>6</sup>	<b>1,2</b>
27	M1074-68503	M1074-66503 <sup>5</sup>	DSPC Controller with Asian & Greek, Russian and Polish character sets <sup>6</sup>	<b>1,2</b>
28		M1204-60400	CDCI Board	<b>1,2</b>

**Table 11-2 Model V24C/V26C Replaceable Parts - Agilent M1204A Color Mainframe(Continued)**

Item	Exchange Part Number	New Part Number	Description	Version
29		M1204-61026 <sup>2</sup>	Board Shield	<b>1</b>
30		M1204-01205 <sup>4</sup>	Flat Panel Bracket	<b>1</b>
32		M1204-01307	Shield, EMI/RFI	<b>2</b>
33		M1204-01305	Frame, Color Display	<b>2</b>
34		M1204-62070	Flat Panel Display Controller Cable	<b>2</b>
35		M1204-01306	Bracket, Color Display	<b>2,3,4</b>
36		2090-0360	Backlight Tube	<b>2,3,4</b>
37		2090-0352	10.4" TFT Color Display	<b>2,3</b>
38		M1095-61602	Converter Cable Assembly (not shown)	<b>2,3,4</b>
39		2090-0376	Flat Panel Display – implemented with PDC 3931	<b>4</b>
40		M1204-60180	LCD Data Cable	<b>3,4</b>
41		M1275-60170	Keyboard Cable	<b>3,4</b>
42		M1204-60150	Power Cable between System Board & Power Supply: for Opt 027	<b>3,4</b>
43		M1204-66202	Display Driver Board Assembly	<b>3,4</b>
44		M1204-62072	Color Display Flex Cable	<b>3,4</b>
45		M1204-01304	Color Display Frame	<b>3,4</b>

<sup>1</sup> Front Housing Kit does not include Flat Panel Display Assembly.

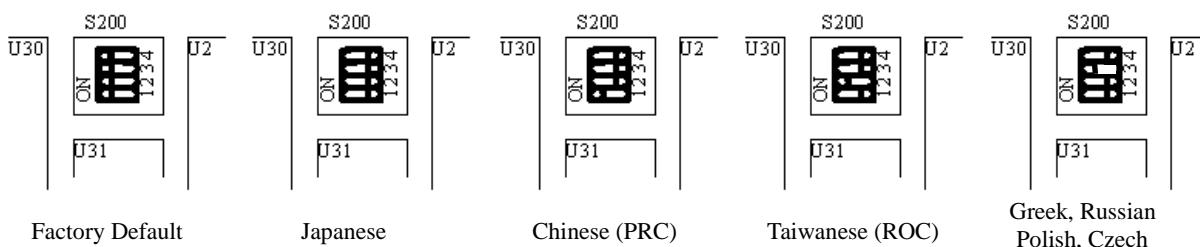
<sup>2</sup> Insulator attaches to Board Shield to insulate Flat Panel Display Cable (old insulator not reusable).

<sup>3</sup> RFI shielding for external defib sync cable.

<sup>4</sup> Color Flat Panel bracket includes RFI springs.

<sup>5</sup> When ordering the color display controller (DSPC Bd.), bracket with RFI springs used for CMS must be removed (2 screws) prior to installation into Model V24C/V26C. Bracket must be installed onto defective DSPC Bd. before returning to Agilent.

<sup>6</sup> If you are replacing the flatscreen controller card with Asian/Eastern Europe language option fitted, you need to set the DIP switches on the function card to select the correct language:



Factory Default

Japanese

Chinese (PRC)

Taiwanese (ROC)

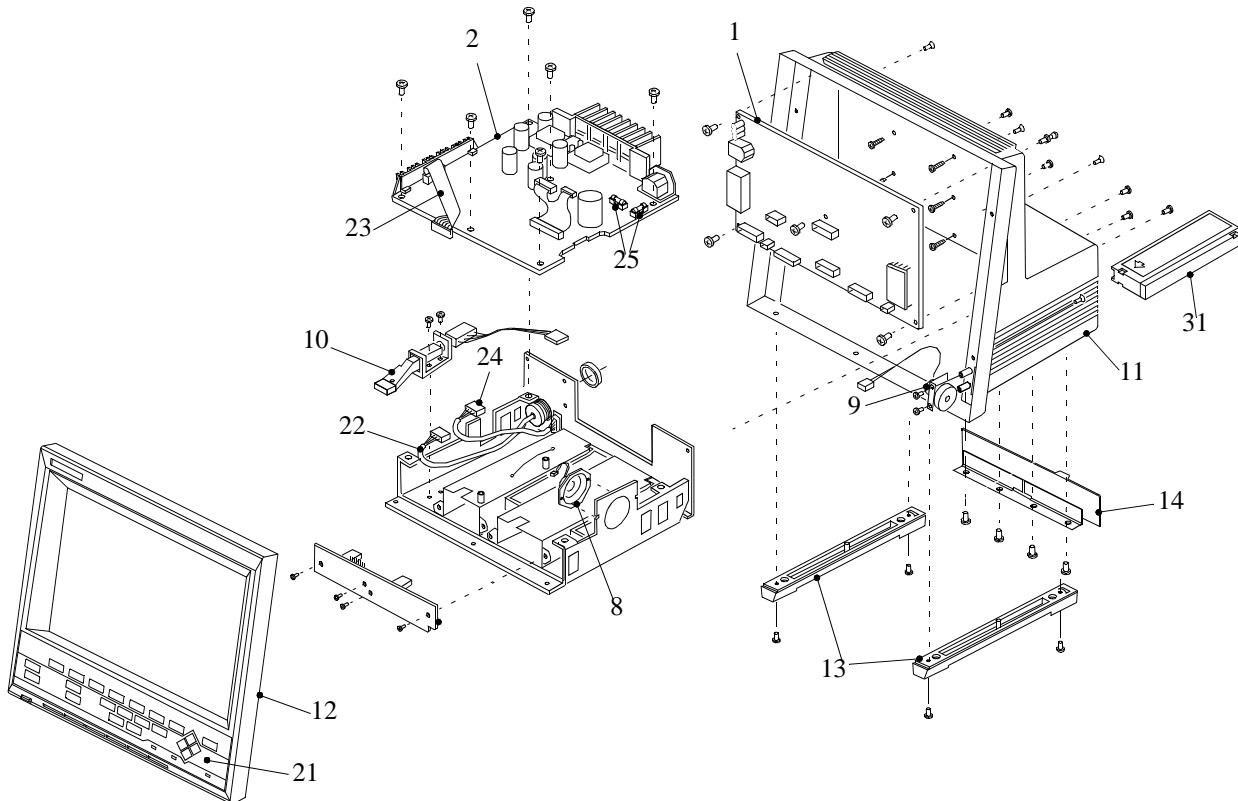
Greek, Russian  
Polish, Czech

Language	DIP Switch Settings			
	1	2	3	4
Factory Default <sup>a</sup>	closed	closed	closed	closed
Japanese	open	open	open	open
Chinese (PRC)	closed	open	open	open
Taiwanese (ROC)	open	closed	open	open
Greek, Russian, Polish, Czech	open	open	closed	open

a. supports all languages except Japanese, Chinese (PRC), Taiwanese (ROC), Greek, Polish, Russian and Czech

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## Model V24CT/V26CT Field Replaceable Parts (Color Battery Mainframe)

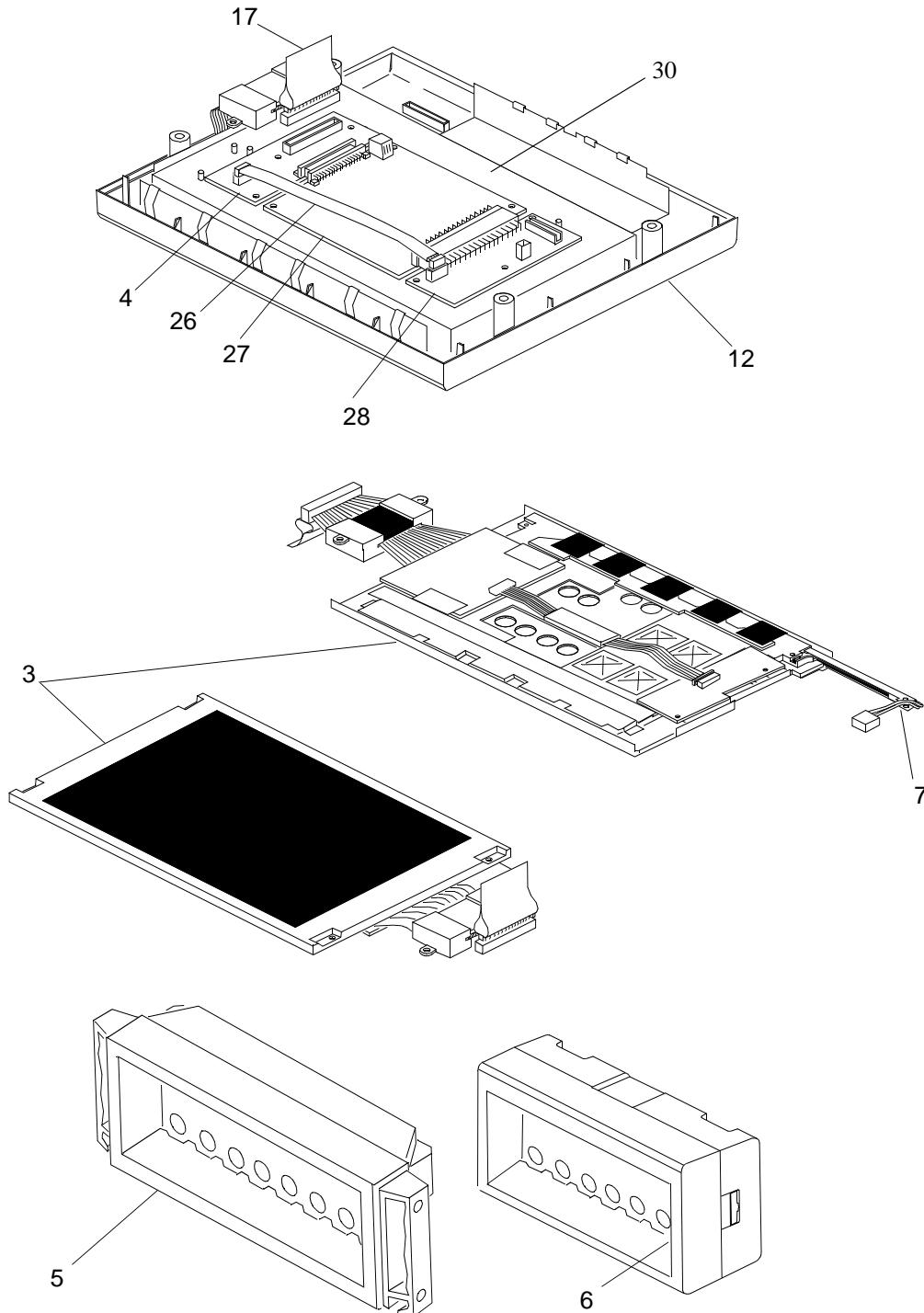


The Agilent V24C/V26C and V24CT/V26CT Models exist with 4 different front housing assembly versions. To help you identify the correct parts for your front housing version, refer to the following table:

Option	Prefix Date Code	Version
021 to 025 J90	— 3931 or greater	1
026 to 029	Less than 3927	2
027 and 028	3927 or greater	3
027 and 028	3931 or greater	4

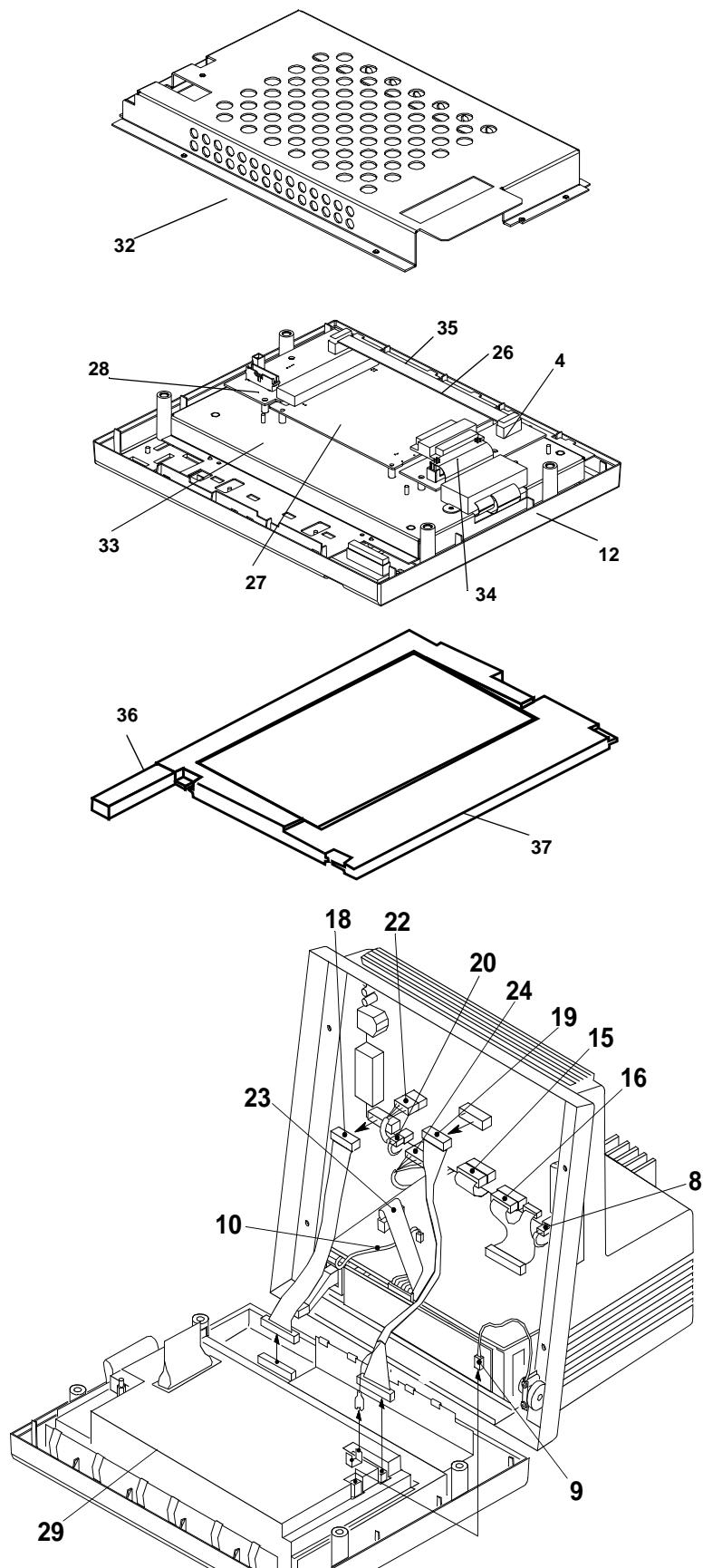
**Version 1 Model V24C/V26C/V24CT/V26CT Field Replaceable Parts (Color Mainframe, Old display #021, #022, #023, #024, #025)**

Replacement Parts

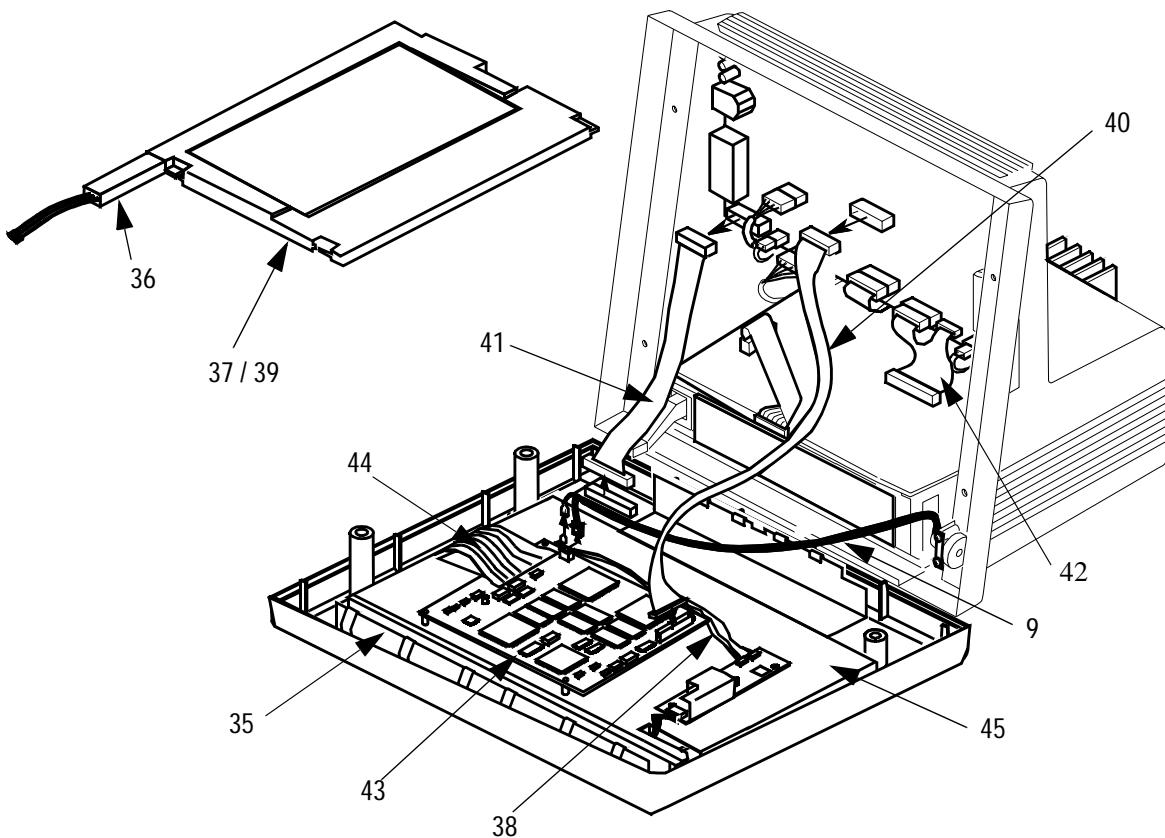


## **Version 2**

**Model V24C/V26C/V24CT/V26CT Field Replaceable Parts (Color Mainframe, New display #026, #027, #028, #029)**



**Version 3&4**



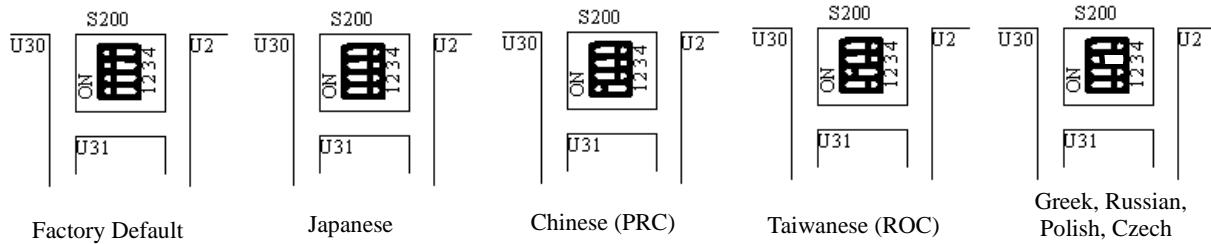
**Table 11-3 Model V24CT/V26CT Replaceable Parts - Agilent M1204A Color Battery Mainframe***Note: If nothing is stated in the Version column the part applies for all versions*

Item	Exchange Part Number	New Part Number	Description	Versions
1	M1204-68102	M1204-60102	System Board	
2	M1204-69086	M1204-61086	Power Supply Assembly	
3		2090-0347	Flat Panel Display, Color	<b>1</b>
4		M1204-66201	Flat Panel Adapter Board	<b>1,2</b>
5	M1041-68001 (old color) M1041-68101(new color)	M1041-60001 (old color) M1041-60101 (new color)	8 Slot Plug-In Rack	
6	M1276-68001 (old color) M1276-68002 (new color)	M1276-60001 (old color) M1276-60003 (new color)	6 Slot Plug-In Rack	
7		2090-0546	Flat Panel Backlight Tube Assembly	<b>1</b>
8		M1204-61025	Speaker Assembly	
9		M1204-61109 M1204-61108	Flat Panel Brightness Control Assembly Opt 024, 025 Flat Panel Brightness Control Assembly Opt 028, 029	
10		M1275-61010	Power Switch Assembly	
11		M1204-67012	Rear Housing Kit	
12		M1204-67906	Front Housing Kit with Antiglare Screen	
13		M1204-40910	Monitor Foot	
14		M1275-61970	Battery Door	
15		M1275-60165	Cable, Battery Docking	
16		M1204-60155	Cable, 5V/12V Power Supply to System Board	
17		M1204-60055	Cable, Flat Panel to Flat Panel Adapter Board (with ferrite block)	<b>1</b>
18		M1204-60074	Cable, Keypad to System Board	
19		M1204-60076	Cable, Flat Panel Data	<b>1,2</b>
20		M1204-60195	Cable, 60V, Power Supply to System Board	
21		M1204-62041	Keypad, English	
21		M1204-62042	Keypad, French	
21		M1204-62043	Keypad, German	
21		M1204-62044	Keypad, Dutch	
21		M1204-62045	Keypad, Spanish	
21		M1204-62046	Keypad, Italian	
21		M1204-62047	Keypad, Swedish	
21		M1204-62048	Keypad, Finnish	
21		M1204-62049	Keypad, Norwegian	
21		M1204-62050	Keypad, Danish	
21		M1204-62051	Keypad, Japanese	
21		M1204-62052	Keypad, Traditional Chinese	
21		M1204-62053	Keypad, Simplified Chinese	
21		M1204-62054	Keypad, Portuguese	

**Table 11-3 Model V24CT/V26CT Replaceable Parts - Agilent M1204A Color Battery Mainframe (Continued)***Note: If nothing is stated in the Version column the part applies for all versions*

Item	Exchange Part Number	New Part Number	Description	Versions
21		M1204-62055	Keypad, Greek	
21		M1204-62057	Keypad, Russian	
21		M1204-62060	Keypad, Polish	
		M1204-62058	Keypad, Czech	
22		M1204-60140	SDN Connector Assembly	
23		M1275-60180	Cable, Battery Contact	
24		M1204-60130	Internal RS232 Cable	
		M1204-60192	RS232 Cable (Printer)	
		0403-0776	Bumper Snap-in	
		1818-5130	EEPROM IC (150ns)	
		M1204-40989	Service Port Cover	
		M1204-61955	Handle Assembly	
		M1204-83014 <sup>2</sup>	Insulator	
		9170-1521 <sup>3</sup>	Core Shielding Bead	
25		2110-0633	Fuse (F1, F2) 2.0A/250V	
26		M1204-60070	Flat Panel Power Cable (12V)	<b>1,2</b>
27	M1074-68501/68502	M1074-66502 <sup>5</sup>	DSPC_Flat Controller	<b>1,2</b>
27	M1074-68503	M1074-66503 <sup>5</sup>	DSPC Controller with Asian character sets <sup>6</sup>	<b>1,2</b>
27	M1074-68503	M1074-66503 <sup>5</sup>	DSPC Controller with Asian, Greek, Russian & Polish character sets <sup>6</sup>	<b>1,2</b>
28		M1204-60400	CDCI Board	<b>1,2</b>
29		M1204-61026 <sup>2</sup>	Board Shield	<b>1</b>
30		M1204-01205 <sup>4</sup>	Flat Panel Bracket	<b>1</b>
31		40488A	Lead Acid Batteries	
32		M1204-01307	Shield, EMI/RFI	<b>2</b>
33		M1204-01305	Frame, Color Display	<b>2</b>
34		M1204-62070	Flat Panel Display Controller Cable	<b>2</b>
35		M1204-01306	Bracket, Color Display	<b>2,3,4</b>
36		2090-0360	Backlight Tube	<b>2,3,4</b>
37		2090-0352	10.4" TFT Color Display	<b>2,3</b>
38		M1095-61602	Converter Cable Assembly (not shown)	<b>2,3,4</b>
39		2090-0376	Flat Panel Display – implemented with PDC 3931	<b>4</b>
40		M1204-60180	LCD Data Cable	<b>3,4</b>
41		M1275-60170	Keyboard Cable	<b>3,4</b>
42		M1204-60155	Power Cable between System Board & Power Supply: for Opt 028	<b>3,4</b>
43		M1204-66202	Display Driver Board Assembly	<b>3,4</b>
44		M1204-62072	Color Display Flex Cable	<b>3,4</b>
45		M1204-01304	Color Display Frame	<b>3,4</b>

- <sup>1</sup> Front Housing Kit does not include Flat Panel Display Assembly.
- <sup>2</sup> Insulator attaches to Board Shield to insulate Flat Panel Display Cable (old insulator not reusable).
- <sup>3</sup> RFI shielding for external defib sync cable.
- <sup>4</sup> Color Flat Panel bracket includes RFI springs.
- <sup>5</sup> When ordering the color display controller (DSPC Bd.), bracket with RFI springs used for CMS must be removed (2 screws) prior to installation into Model V24CT/V26CT. Bracket must be installed onto defective DSPC Bd. before returning to Agilent.
- <sup>6</sup> If you are replacing the flatscreen controller card with Asian/Eastern Europe language option fitted, you need to set the DIP switches on the function card to select the correct language:



Language	DIP Switch Settings			
	1	2	3	4
Factory Default <sup>a</sup>	closed	closed	closed	closed
Japanese	open	open	open	open
Chinese (PRC)	closed	open	open	open
Taiwanese (ROC)	open	closed	open	open
Greek, Russian, Polish, Czech	open	open	closed	open

a. supports all languages except Japanese, Chinese (PRC), Taiwanese (ROC), Greek, Polish, Russian and Czech

## Plug-In Modules

The following table shows the part-numbers of the plug-in modules that can be replaced. Find the right number for your language combining the P/N-Prefix with the language-specific suffix for the wanted module. E.g.: To order a TEMP module for a French language model, the correct order number would be M1029-68801.

**Table 11-4 Plug-In Modules - Replaceable Modules (New Color)**

Module Type	P/N Prefix	Language Suffixes												
		US English	English	French	German	Dutch	Spanish	Italian	Norwegian	Swedish	Finish	Japanese	Danish	Chinese
BLANK MODULE	M1180-64	511	511	511	511	511	511	511	511	511	511	511	511	
DATA TRANSFER	M1235-68	601	601	602	602	602	602	602	602	602	602	602	602	
M1116A or M1116B THERMAL ARRAY RECORDER	M1116-68	521	521	522	523	521	525	526	528	528	528	530	521	533
VUELINK AUXILIARY #A01	M1032-68	701	801	801	801	801	801	801	801	801	801	801	801	
VUELINK VENTILATOR #A02	M1032-68	702	802	802	802	802	802	802	802	802	802	802	802	
VUELINK GAS ANALYZER #A03	M1032-68	703	803	803	803	803	803	803	803	803	803	803	803	
VUELINK ANESTHESIA MACHINE #A04	M1032-68	704	804	804	804	804	804	804	804	804	804	804	804	
VUELINK AUXILIARY PLUS #A05	M1032-68	705	805	805	805	805	805	805	805	805	805	805	805	
TEMP	M1029-68	701	801	801	801	801	801	801	801	801	709	710	801	713
SpO <sub>2</sub> /PLETH	M1020-68	603	603	603	603	603	605	605	605	605	605	610	605	613
tcpO <sub>2</sub> /tcpCO <sub>2</sub>	M1018-68	601	601	601	601	601	601	601	601	601	601	610	601	601
CO <sub>2</sub>	M1016-68	601	701	701	701	701	701	701	701	701	701	610	701	613
SIDESTREAM CO <sub>2</sub>	M1015-68	601	601	601	601	601	601	601	601	601	601	601	601	601
C.O.	M1012-68	601	701	602	603	701	605	606	701	701	701	610	701	613
NBP Venous Puncture	M1008-68	803	811	812	811	814	815	816	817	818	811	820	811	823
NBP (Non-VP)	M1008-68	503	603	512	603	514	515	516	517	518	603	520	603	523
M1006B INV. PRESSURE	M1006-68	621	721	632	633	634	635	721	637	638	639	640	721	643
M1006B Option #C01 IABP	M1006-68	625	725	662	663	664	665	666	667	668	669	670	725	673
ECG (M1001A)	M1001-68	603	703	703	653	703	703	703	657	657	657	670	703	673
ECG (M1001B)	M1001-68	611	611	611	613	611	611	611	617	617	617	620	611	623
ECG/RESP (M1002A)	M1002-68	603	703	703	653	703	703	703	657	657	657	670	703	673
ECG/RESP (M1002B)	M1002-68	611	611	611	613	611	611	611	617	617	617	620	611	623
ECG/RESP Option #CO1	M1002-68	625	625	625	633	625	625	625	625	625	625	625	625	625
BIS	M1034-68	500	500	500	500	500	500	500	500	500	500	500	500	500

**Table 11-5 Blood Analysis Plug-In Module - Replaceable Modules**

Exchange P/N	New P/N	Country
M1022-68531	M1022-60531	USA
M1022-68532	M1022-60532	France
M1022-68533	M1022-60533	Austria/Germany
M1022-68534	M1022-60534	Netherlands
M1022-68535	M1022-60535	Spain
M1022-68536	M1022-60536	Italy
M1022-68537	M1022-60537	Norway
M1022-68538	M1022-60538	Sweden
M1022-68539	M1022-60539	Finland
M1022-68540	M1022-60540	Japan
M1022-68541	M1022-60541	Denmark
M1022-68542	M1022-60542	Traditional Chinese
M1022-68543	M1022-60543	Simplified Chinese
M1022-68544	M1022-60544	Portuguese
M1022-68551	M1022-60551	UK
M1022-68552	M1022-60552	Canada
M1022-68553	M1022-60553	Austria
M1022-68554	M1022-60554	Switzerland
M1022-68555	M1022-60555	Latin America and others

**Table 11-6 Plug-In Modules - Replaceable Parts**

Part Number	Description	Item
M1008-47201	NBP INLET CONNECTOR INSERT	
M1008-60003	NBP PUMP	
M1018-67911	tcpO <sub>2</sub> /CO <sub>2</sub> CALIBRATION CHAMBER KIT (including front housing)	
M1022-68000	FOAM FILTER FOR VENTILATOR FAN for M1022A (PACK OF 5)	
M1022-68070	COVER FOR VENTILATOR FILTER for M1022A (PACK OF 5)	
M1032-44111	VUELINK MODULE LED COVER	
M1032-45211	VUELINK MODULE FRONT FRAME	
M1116-40041	TOP HOUSING (FITS M1116 A & M1116 B MODELS)	
M1116-40240	FRONT HOUSING, M1116 B (DOOR)	
M1116-60201	M1116B RECORDER CLEANING KIT	
M1116-60400	REAR CONNECTOR (M1116A, M1116B)	
M1116-83002	LABEL, INSIDE DOOR, TRANSPARENT, M1116 B (LOAD PAPER)	
M1235-60010	DTM MAIN BOARD AND FRONT PANEL ASSBLY	
1252-2655	C.O. CONNECTOR	9
1252-2708	C.O. CONNECTOR BEZEL (ORANGE)	11
1252-2657	CO <sub>2</sub> CONNECTOR	9

**Table 11-6 Plug-In Modules - Replaceable Parts**

<b>Part Number</b>	<b>Description</b>	<b>Item</b>
1252-2706	CO <sub>2</sub> CONNECTOR BEZEL (LIGHT GREY)	11
1252-2656	ECG or ECG/RESP CONNECTOR	9
1252-2709	ECG or ECG/RESP CONNECTOR BEZEL (WHITE)	11
5061-8310	FRAME KIT	4 & 5
5041-4254	FRAME MIDDLE	6
5040-4256	HOUSING FRONT, DOUBLE MODULE	3
5040-4250	HOUSING FRONT, SINGLE MODULE	2
5041-8135	HOUSING, DOUBLE MODULE	
5040-4249	HOUSING, SINGLE MODULE	
5041-9702	IABP HOUSING FRONT, DOUBLE (M1006A #C01)	
1990-0698	LED PARAM MODULE	7
1252-2659	M1006A PRESS CONNECTOR	9
1252-5681	M1006B PRESS CONNECTOR	9
1252-2663	MODULE REAR CONNECTOR	
1252-5618	MODULE REAR CONNECTOR (M1006B, M1032A)	
1252-5618	MODULE REAR CONNECTOR (NEW)	
1252-2663	MODULE REAR CONNECTOR (OLD)	
1252-2714	NBP CONNECTOR BEZEL (RED)	
1252-2702	PHONE JACK SOCKET for M1006B #C01	
1252-2715	PRESS CONNECTOR BEZEL (RED)	11
5040-4247	SNAP LOCK SINGLE	10
1252-2654	SpO <sub>2</sub> CONNECTOR	9
1252-2707	SpO <sub>2</sub> CONNECTOR BEZEL (BLUE)	11
3101-2990	SWITCH PARAM MODULE	8
1252-4606	tcpO <sub>2</sub> /CO <sub>2</sub> CONNECTOR BEZEL (BLACK)	11
1252-2660	TEMP CONNECTOR	9
1252-2711	TEMP CONNECTOR BEZEL (BROWN)	11
1252-4604	VUELINK CONNECTOR	9
1252-4605	VUELINK CONNECTOR BEZEL (DARK GREY)	11

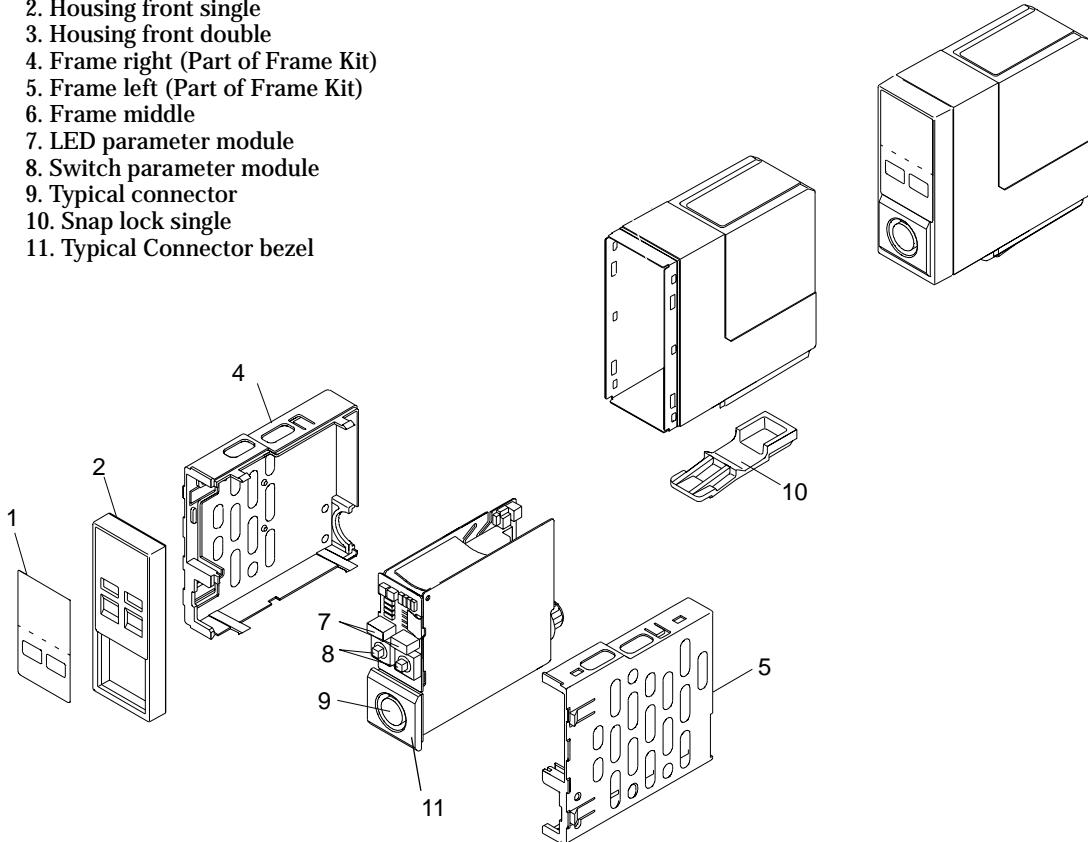
**Table 11-7 BIS Module - Replaceable Parts**

<b>Part Number</b>	<b>Description</b>	
M1034-61630	BIS PIC (PATIENT INTERFACE CABLE)	14
M1034-61650	BIS SENSOR SIMULATOR	
M1034-68520	BIS ENGINE	12
M1034-68530	BIS DSC-3	13
M1034-61610	BIS MODULE CABLE (0.8 m)	11
M1034-61620	BIS MODULE CABLE (2.0 m)	11

## **Exploded view of single width Parameter Module**

**Parts include:**

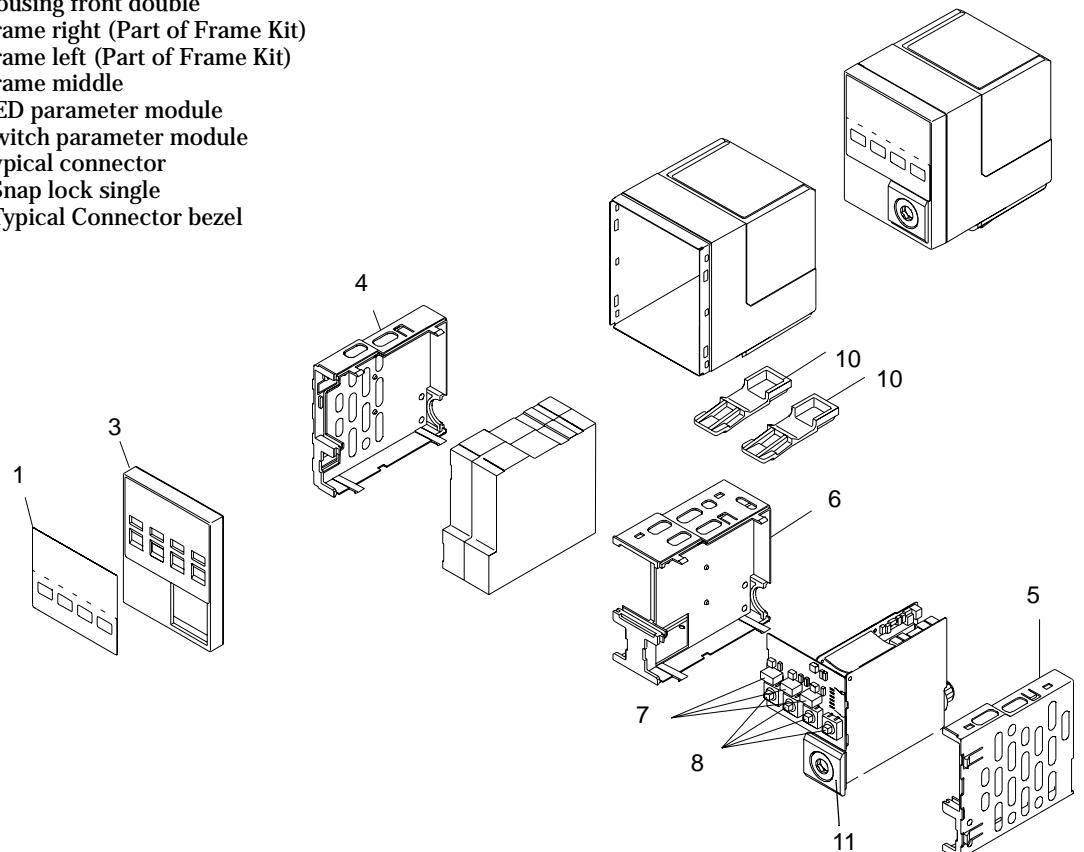
- (also shown on next page)
- 1. Typical overlay label
  - 2. Housing front single
  - 3. Housing front double
  - 4. Frame right (Part of Frame Kit)
  - 5. Frame left (Part of Frame Kit)
  - 6. Frame middle
  - 7. LED parameter module
  - 8. Switch parameter module
  - 9. Typical connector
  - 10. Snap lock single
  - 11. Typical Connector bezel



## Exploded view of double width Parameter Module

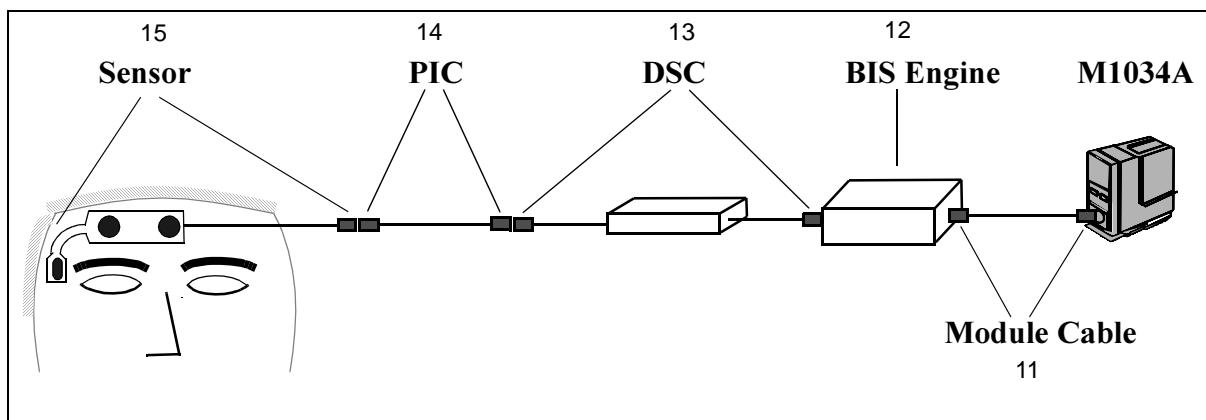
Parts include:

1. Typical overlay label
2. Housing front single
3. Housing front double
4. Frame right (Part of Frame Kit)
5. Frame left (Part of Frame Kit)
6. Frame middle
7. LED parameter module
8. Switch parameter module
9. Typical connector
10. Snap lock single
11. Typical Connector bezel



Replacement Parts

## BIS Module Components



**NOTE**

Module labels are not available for all languages.

**Table 11-8 Plug-In Module Label Part Numbers with T**

<b>Module</b>	<b>Old (Dark) Color</b>	<b>New (Light) Color</b>	<b>Chinese</b>	<b>Japanese</b>	<b>Italian</b>	<b>Spanish</b>	<b>French</b>	<b>English</b>	<b>Dutch</b>	<b>Danish</b>	<b>German</b>	<b>Finnish</b>	<b>Norwegian</b>	<b>Swedish</b>
VueLink	M1032-443xx	M1032-444xx	'01	'01	'01	'01	'01	'01	'01	'01	'01	'01	'01	'01
Temp	M1029-443xx	M1029-444xx	'82	'81	'71	'71	'71	'71	'71	'71	'71	'78	'71	'71
SpO <sub>2</sub> /Pleth	M1020-443xx	M1020-444xx	'82	'81	'75	'75	'71	'71	'71	'71	'71	'71	'71	'75
tcpO <sub>2</sub> /tcpCO <sub>2</sub>	M1018-443xx	M1018-444xx	'71	'81	'71	'71	'71	'71	'71	'71	'71	'71	'71	'71
CO <sub>2</sub>	M1016-443xx	M1016-444xx	'82	'81	'71	'71	'71	'71	'71	'71	'71	'77	'71	'71
Sidestream CO <sub>2</sub>	M1015-443xx	M1015-444xx	'82	'81	'71	'71	'71	'71	'82	'81	'71	'71	'71	'71
C.O.	M1012-443xx	M1012-444xx	'82	'81	'76	'75	'72	'71	'71	'71	'73	'71	'71	'71
NBP B Ven Puncture.	—	M1008-444xx	'82	'81	'76	'75	'72	'71	'74	—	'73	'71	'79	'77
NBP B	M1008-443xx	M1008-444xx	'52	'51	'46	'45	'42	'41	'44	'41	'43	'41	'49	'47
IABP A	M1006-443xx	—	'70	'68	'66	'65	'62	'70	'64	'70	'63	'70	'69	'70
IABP B	M1006-444xx	M1006-445xx	'32	'31	'26	'25	'22	'21	'24	—	'23	'28	'29	'27
Pressure A	M1006-443xx	—	'82	'81	'71	'75	'72	'71	'74	'71	'73	'78	'79	'77
Pressure B	M1006-444xx	M1006-445xx	'12	'11	'01	'05	'02	'01	'04	'01	'03	'08	'09	'07
ECG/Resp (A)	M1002-443xx	M1002-444xx	'82	'81	'71	'71	'71	'71	'71	'71	'73	'77	'77	'77
ECG/Resp (B)	—	M1002-44xxx	'502	'501	'491	'491	'491	'491	'91	'91	'93	'97	'97	'97
ECG/Resp #C01	M1002-443xx	M1002-444xx	'21	'21	'21	'21	'21	'21	'21	'21	'23	'21	'21	'21
ECG (A)	M1001-443xx	M1001-444xx	'82	'81	'71	'71	'71	'71	'71	'71	'73	'77	'77	'77
ECG (B)	—	M1001-44xxx	'502	'501	'491	'491	'491	'491	'91	'91	'93	'97	'97	'97
Data Transfer	M1235-830xx	M1235-831xx	'00	'00	'00	'00	'00	'01	'00	'00	'00	'00	'00	'00
Blood Analysis	—	M1022-444xx	'52	'50	'46	'45	'42	'41	'44	'51	'43	'49	'47	'48
BIS	—	M1034-444xx	'01	'01	'01	'01	'01	'01	'01	'01	'01	'01	'01	'01

**Table 11-9 Plug-In Module Label Part Numbers without T**

<b>Module</b>	<b>Old (Dark) Color</b>	<b>Japanese</b>	<b>Swedish</b>	<b>Italian</b>	<b>Spanish</b>	<b>Dutch</b>	<b>German</b>	<b>French</b>	<b>English</b>	<b>Chinese</b>
Recorder A	M1116-830xx	'90	'60	'50	'40	'20	'20	'10	'00	—
Recorder B	M1116-830xx	'28	'26	'29	'24	'23	'23	'25	'21	'27
SaO <sub>2</sub> /Pleth	M1020-443xx	'11	'05	'05	'05	'01	'01	'01	'01	---
NBP B	M1008-443xx	'31	'27	'26	'25	'24	'23	'22	'21	---
NBP A	M1008-443xx	'11	'07	'06	'05	'04	'03	'02	'01	---
ECG/Resp	M1002-443xx	'11	'07	'01	'01	'01	'03	'01	'01	---
ECG	M1001-443xx	'11	'07	'01	'01	'01	'03	'01	'01	---

---

## Plug-in Module Racks

Replaceable parts on either the integral module rack or the satellite module rack are:

**Table 11-10 Plug-in Module Racks - Replaceable Parts**

Exchange Part Number	New Part Number	Description
M1276-68001	M1043-60101	INTERNAL RACK 6-SLOT
M1041-68101	M1041-60101	SATELLITE RACK 8-SLOT
	M1043-60102	BLANK RACK
	M1043-40211	BLANK FRONT COVER (for Blank Rack)
	M1041-44911	HANDLE EXTRACK
	M1041-44112	COVER CONNECT (EXT RACK)

## Patient Connectors and Accessories

### General

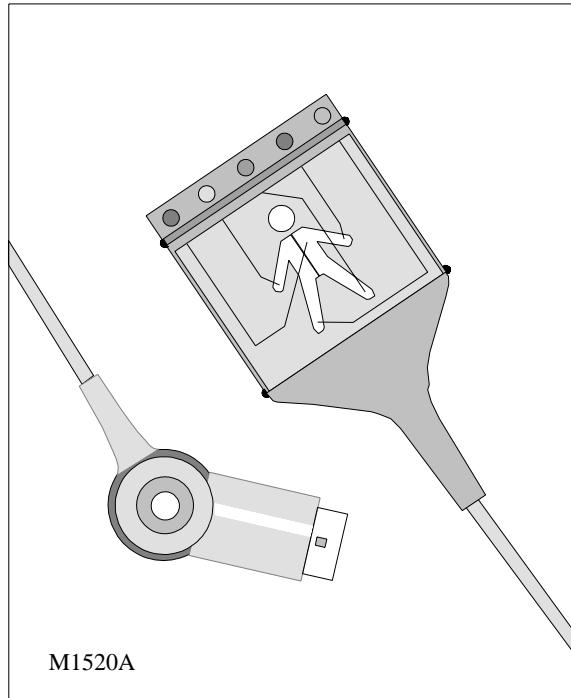
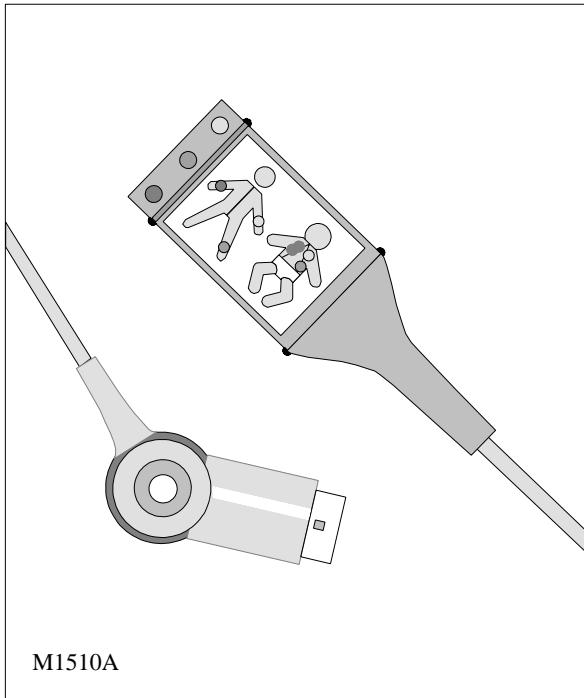
**Table 11-11 General Accessories**

New Part Number	Description
M2281A	Patient Cable Organizer (pack of 8 hooks)

### ECG & ECG/Respiration Module Accessories

The cabling and associated parts that can be ordered for the ECG and ECG/Respiration modules are:

mrx-ecg1

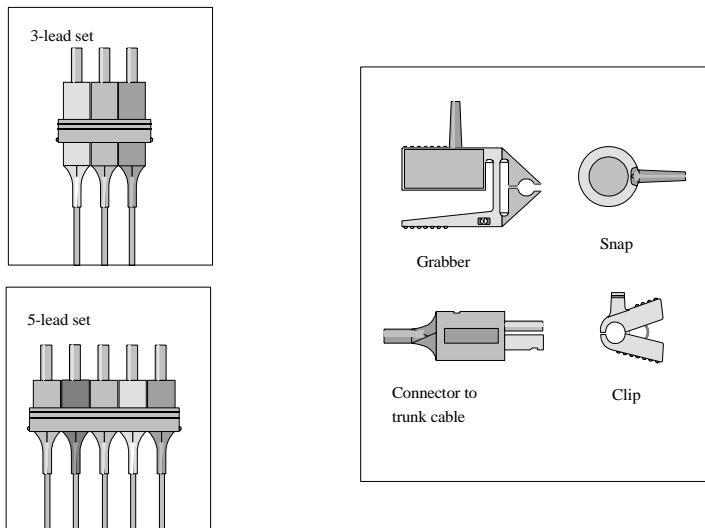


**Table 11-12 ECG & ECG/Respiration Trunk Cables**

	US Standard	IEC Standard
3 lead, 2.7m	M1500A	M1510A
3 lead, 0.4m	M1540C	M1550C
5 lead, 2.7m	M1520A	M1530A
5 lead, 0.4m	M1560A	M1570A

**Table 11-13 ECG & ECG/Respiration One Piece Cables**

	US Standard	IEC Standard
3 lead, OR, 1.9m	M1970A	M1980A
3 lead, ICU (Snap), 1.9m	M1972A	----
3 lead, ICU (Grabber), 1.9m	----	M1981A
5 lead, OR, 2.5m	M1975A	M1985A
5 lead, ICU (Snap), 2.5m	M1977A	----
5 lead, ICU (Grabber), 2.5m	----	M1986A

**Table 11-14 ECG & ECG/Respiration OR Lead Sets**

	US Standard	IEC Standard
OR 3 lead, 0.7m, Grabber	M1601A	M1611A
OR 5 lead, 0.7m 1.3m leg, Grabber	M1621A	M1631A

**Table 11-15 ECG & ECG/Respiration Shielded Lead Sets**

	US Standard	IEC Standard
Shielded 3 lead, 0.7m, Grabber	M1603A	M1613A
Shielded 3 lead, 0.7m, Snap	M1605A	M1615A
Shielded 5 lead, 0.7m (1.3m leg), Grabber	M1623A	M1633A
Shielded 5 lead, 0.7m (1.3m leg), Snap	M1625A	M1635A

**Table 11-16 ECG & ECG/Respiration Unshielded Lead Sets**

	US Standard	IEC Standard
Unshld. 3 lead, 0.45m, Mini Clip	M1608A	M1618A
Unshld. 3 lead, 0.7m, Mini Clip	M1609A	M1619A
Unshld. 5 lead, 0.7m (1.3m leg), Mini Clip	M1629A	M1639A

**Table 11-17 ECG & ECG/Respiration Single Leads**

New Part Number	Description	New Part Number	Description
M1511A	Grabber, OR, 0.7m, Black	M1544A	Snap, STD, 0.7m, White
M1512A	Grabber, OR, 0.7m, Green	M1545A	Snap, STD, 0.7m, Yellow
M1513A	Grabber, OR, 0.7m, Red	M1546A	Snap, STD, 0.7m, Brown
M1514A	Grabber, OR, 0.7m, White	M1547A	Snap, STD, 1.3m, Black
M1515A	Grabber, OR, 0.7m, Yellow	M1548A	Snap, STD, 1.3m, Green
M1516A	Grabber, OR, 0.7m, Brown	M1549A	Snap, STD, 1.3m, Red
M1517A	Grabber, OR, 1.3m, Black	M1581A	Clip, Uns, 0.7m, Black
M1518A	Grabber, OR, 1.3m, Green	M1582A	Clip, Uns, 0.7m, Green
M1519A	Grabber, OR, 1.3m, Red	M1583A	Clip, Uns, 0.7m, Red
M1521A	Grabber, STD, 0.7m, Black	M1584A	Clip, Uns, 0.7m, White
M1522A	Grabber, STD, 0.7m, Green	M1585A	Clip, Uns, 0.7m, Yellow
M1523A	Grabber, STD, 0.7m, Red	M1586A	Clip, Uns, 0.7m, Brown
M1524A	Grabber, STD, 0.7m, White	M1587A	Clip, Uns, 1.3m, Black
M1525A	Grabber, STD, 0.7m, Yellow	M1588A	Clip, Uns, 1.3m, Green
M1526A	Grabber, STD, 0.7m, Brown	M1589A	Clip, Uns, 1.3m, Red
M1527A	Grabber, STD, 1.3m, Black	M1591A	Clip, Uns, 0.45m, Black
M1528A	Grabber, STD, 1.3m, Green	M1592A	Clip, Uns, 0.45m, Green
M1529A	Grabber, STD, 1.3m, Red	M1593A	Clip, Uns, 0.45m, Red
M1541A	Snap, STD, 0.7m, Black	M1594A	Clip, Uns, 0.45m, White
M1542A	Snap, STD, 0.7m, Green	M1595A	Clip, Uns, 0.45m, Yellow
M1543A	Snap, STD, 0.7m, Red		

**Table 11-18 ECG & ECG/Respiration Cabling Accessories**

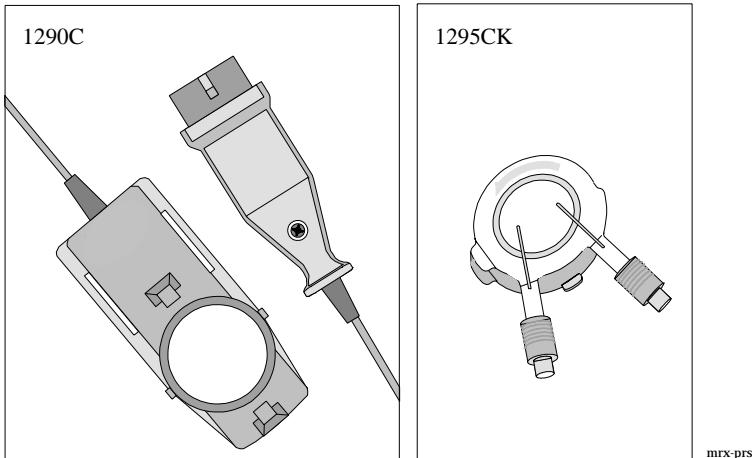
	for 3 lead sets	for 5 lead sets
Combiner block	M1501A	M1502A
Cable organizer (shielded and OR cables)	M1503A	M1504A
Cable organizer (unshielded cables)	M1505A	M1506A
Bedsheet clip, repositionable	M1509A	

**Table 11-19 EASI Accessories**

	US	Non-US
EASI Stickers	5967-2090	5967-2084

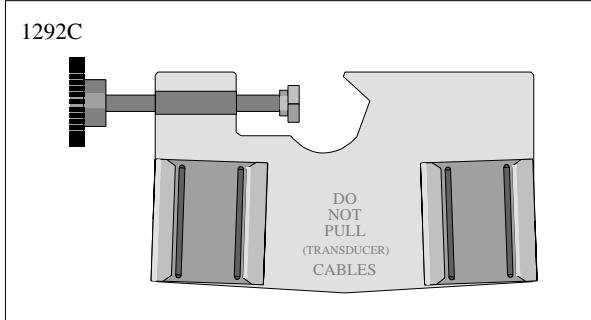
## Pressure Module Accessories

The following accessories can be ordered for the Pressure Module:



**Table 11-20 PRESS Transducers & Adapter Cables**

New Part Number	Description
1290C #J06	Pressure Transducer with 3m cable & 12-pin connector
1290C #J99-11	Pressure Transducer with 1m cable & 12-pin connector
1295CK	Sterile domes



**Table 11-21 PRESS Transducer Accessories**

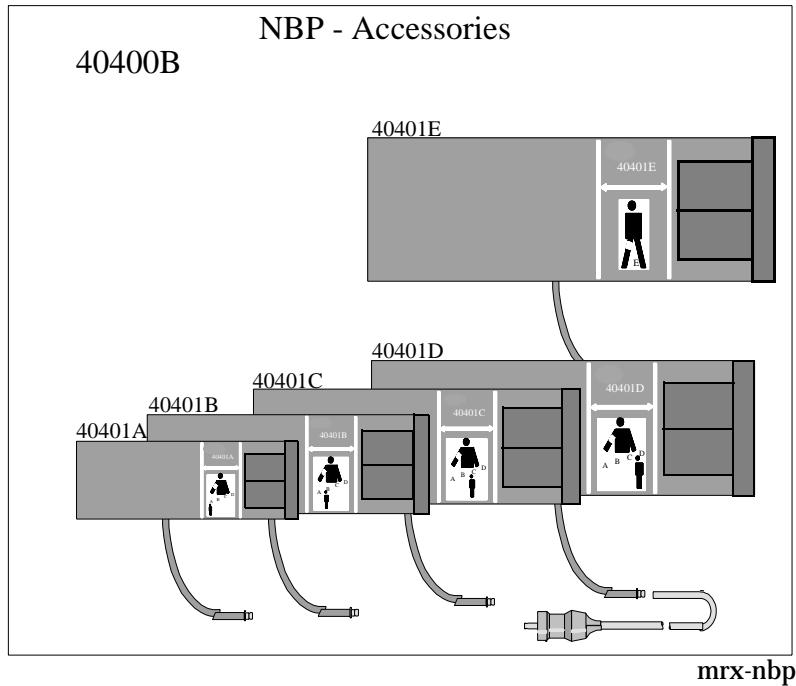
New Part Number	Description
1292C	Holder for two 1290C Transducers
1293C	Holder for three 1290C Transducers
1294C	Holder for four 1290C Transducers

**Table 11-22 M1006B Pressure Module with Analog Output - Cables**

New Part Number	Description
M1181A #A61	3 m IABP Cable
M1181A #A6B	25 m IABP Cable

## Non-Invasive Pressure Module Accessories

The following accessories can be ordered for the Non-Invasive Pressure Module:



**Table 11-23 Pressure Cuffs & Interconnection Cables**

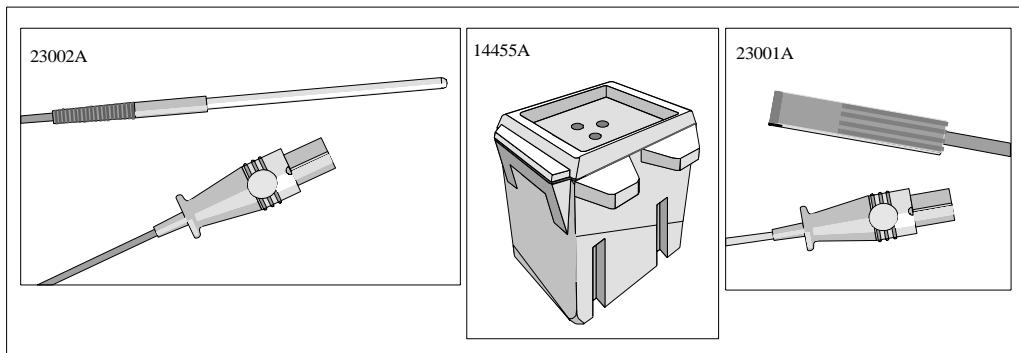
New Part Number	Description
40401A	Reusable pressure cuff, infant, 10-19cm
40401B	Reusable pressure cuff, pediatric, 18-26cm
40401C	Reusable pressure cuff, adult, 25-35cm
40401D	Reusable pressure cuff, large arm, 33-47cm
40401E	Reusable pressure cuff, thigh, 46-66cm
40400A	Reusable pressure cuff kit, includes 40401B/C/D
40400B	Reusable pressure cuff kit, includes 40401A/B/C/D/E
M1571A	Reusable Pressure cuff, infant, 12-17.5cm
M1572A	Reusable Pressure cuff, pediatric, 17-24cm
M1573A	Reusable Pressure cuff, small adult, 22-32cm
M1574A	Reusable Pressure cuff, adult, 27-37.5cm
M1575A	Reusable Pressure cuff, large adult, 37-51cm
M1576A	Reusable Pressure cuff, thigh size, 45-60cm
M1577A	Reusable Pressure cuff, kit, includes M1571/2/3/4A
M1578A	Reusable Pressure cuff, kit, includes M1573/4/5/6A
M1579A	Reusable Pressure cuff, kit, includes M1571/2/3/4/5/6A
M1874A	Non-sterile disposable pressure cuff, infant, 12.0-17.5cm
M1875A	Non-sterile disposable pressure cuff, pediatric, 17-24cm

**Table 11-23 Pressure Cuffs & Interconnection Cables**

New Part Number	Description
M1808A/M1876A	Sterile/Non-sterile disposable pressure cuff, adult, 22-32cm
M1809A/M1877A	Sterile/Non-sterile disposable pressure cuff, adult, 27-37.5cm
M1829A/M1078A	Sterile/Non-sterile disposable pressure cuff, adult, 37-51cm
M1879A	Non-sterile disposable pressure cuff, thigh, 45-60cm
M1867A/M1866A	Sterile/Non-sterile disposable neonatal cuff, size 1, 3.1-5.7cm
M1869A/M1868A	Sterile/Non-sterile disposable neonatal cuff, size 2, 4.3-8.0cm
M1879A/M1870A	Sterile/Non-sterile disposable neonatal cuff, size 3, 5.8-10.9cm
M1873A/M1872A	Sterile/Non-sterile disposable neonatal cuff, size 4, 7.1-13.1cm
M1597	Neonatal interconnect cable, 3m
M1596	Neonatal interconnect cable, 1.5m
M1599	Adult interconnect cable, 3m
M1598	Adult interconnect cable, 1.5m
40401-40010	Cap for liquid seal

## Cardiac Output Module Accessories

The following accessories can be ordered for the Cardiac Output Module:



**Table 11-24 Cardiac Output Temperature Probes & Accessories**

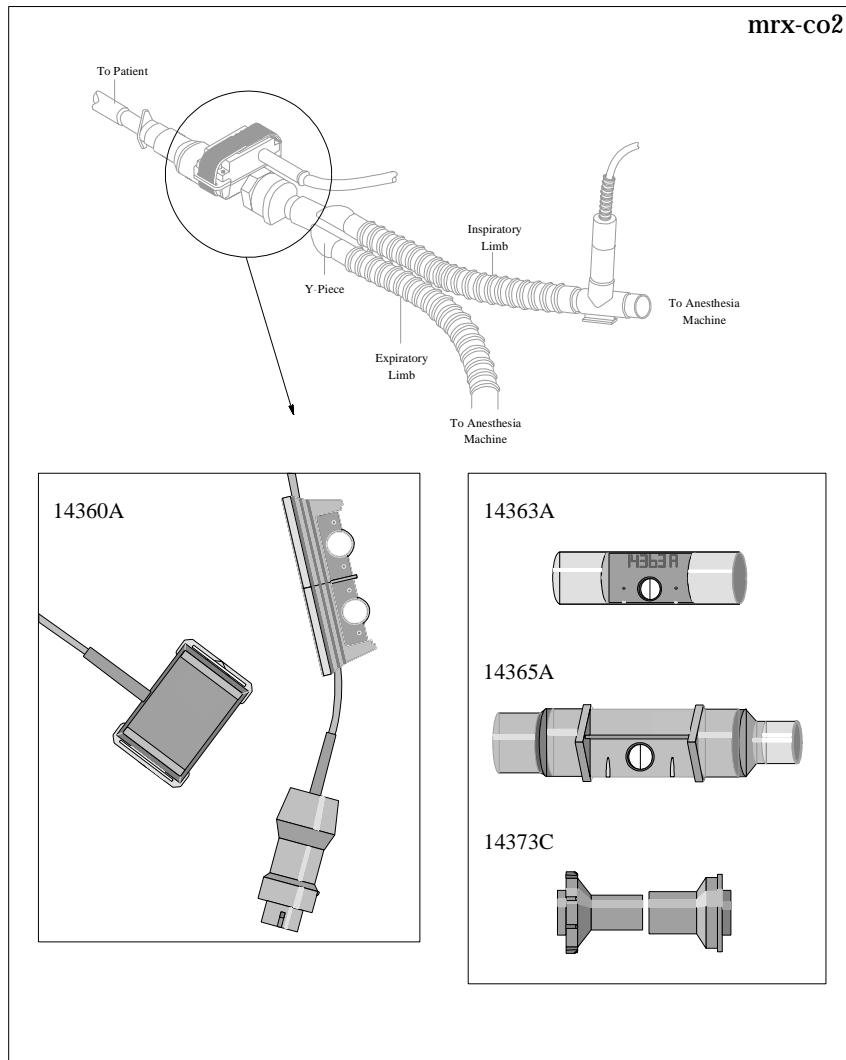
Part Number	Description
14454A	IV pole mount
14455A	Ice bucket for Cardiac Output; styrofoam
15244A	Hand switch
23001A	Reusable Injectate Temp. Probe for Baxter C.O. Set 2.4m
23001B	Reusable Injectate Temp. Probe for Baxter C.O. Set 0.5m
23002A	Ice bath reusable static temp.probe
M1642A	Cardiac Output cable, 2.7m + 0.2m
M1643A	Enhanced Cardiac Output interface cable, 2.4m + 2.4m

**Table 11-25 General Cardiac Output Accessories**

Part Number	Description
M1012-61601	Cardiac Output Service Tool to check proper function of M1012A, M1042A, M1043A

## CO<sub>2</sub> Module Accessories

The following accessories can be ordered for the CO<sub>2</sub> Module:



**Table 11-26 CO<sub>2</sub> Gas Monitoring Accessories**

New Part Number	Description
14360A	Airway CO <sub>2</sub> transducer with calstick (obsolete)
M1460A	Airway CO <sub>2</sub> transducer with calstick
14363A	Reusable pediatric airway adapter
14365A	Reusable adult airway adapter
14373B	Disposable 15mm airway tubing couplers (IEC)
14373C	Disposable 15mm airway tubing couplers (Non-IEC)

## Sidestream CO<sub>2</sub> Module Accessories

The following accessories can be ordered for the Sidestream CO<sub>2</sub> Module:

**Table 11-27 Sidestream CO<sub>2</sub> Gas Monitoring Accessories**

New Part Number	Description
13901A	Sample tube, 2.4 m Nafion
13902A	Elbow airway adaptor, 15 mm
1612AA	Straight airway adaptor
13904A	Bacterial Filter
13905A	Hybrid Sample Tube

## SpO<sub>2</sub> Module Accessories

The following accessories can be ordered for the SpO<sub>2</sub> Module:

**Table 11-28 SpO<sub>2</sub> Monitoring Accessories**

New Part Number	Description
M1190A	Adult SpO <sub>2</sub> transducer, no adapter cable required.
M1191A	Adult SpO <sub>2</sub> transducer, requires M1940 adapter cable.
M1192A	Small Adult/Pediatric SpO <sub>2</sub> transducer, requires M1940 adapter cable.
M1193A	Neonatal SpO <sub>2</sub> transducer, requires M1940 adapter cable.
M1194A	Adult/Pedi SpO <sub>2</sub> transducer, requires M1940 adapter cable.
M1195A	Infant SpO <sub>2</sub> transducer, requires M1940 adapter cable.
M1904A	Disposable NELLCOR® OxisensorII™ adult digit sensor, sterile.
M1903A	Disposable NELLCOR® OxisensorII™ pediatric digit sensor, sterile.
M1902A	Disposable NELLCOR® OxisensorII™ infant digit sensor, sterile.
M1901A	Disposable NELLCOR® OxisensorII™ neonatal foot sensor, sterile.
M1907A	Semi-disposable NELLCOR® Oxiband adult/neonatal sensor, non-sterile
M1906A	Semi-disposable NELLCOR® Oxiband pediatric/infant sensor, non-sterile
M1940A	Adapter cable for use with HP/Agilent Transducers.
M1900B	Adapter cable for use with NELLCOR® Transducers.

## Temperature Module Accessories

The following accessories can be ordered for the Temperature Module:

**Table 11-29 Temperature Probes - Disposable**

New Part Number	Description
21082A	Extension cable for disposable temp. probes, 3m
21082B	Extension cable for disposable temp. probes, 1.5m

**Table 11-29 Temperature Probes - Disposable**

New Part Number	Description
21090A	Disposable general purpose temp. probe
21091A	Disposable skin surface temp. probe
21093A	Disposable esophageal/stethoscope temp. probe, 12fr
21094A	Disposable esophageal/stethoscope temp. probe, 18fr
21095A	Disposable esophageal/stethoscope temp. probe, 24fr
21096A	Disposable Foley Catheter temp. probe, 16fr
21097A	Disposable Foley Catheter temp. probe, 18fr

**Table 11-30 Temperature Probes - Reusable**

New Part Number	Description
21075A	General purpose temp. probe; reusable
21075B	General purpose temp. probe; reusable (Germany)
21076A	Small flexible temp. probe; reusable
21076B	Small flexible temp. probe; reusable (Germany)
21078A	Skin surface temp. probe; tape-on; reusable
21078B	Skin surface temp. probe; tape-on; reusable (Germany)

## tcpO<sub>2</sub>/tcpCO<sub>2</sub> Module Accessories

The following accessories can be ordered for the tcpO<sub>2</sub>/tcpCO<sub>2</sub> Module:

**Table 11-31 tcpO<sub>2</sub>/tcpCO<sub>2</sub> Monitoring Accessories**

New Part Number	Description
M15209-60010	Accessory Kit
M15210-60010	CAL 1 gas (6 bottles - U.S.A. only)
M15210-64010	CAL 1 gas (6 bottles)
M15210-60020	CAL 2 gas (6 bottles - U.S.A. only) Contains: 0% O <sub>2</sub> , 10% CO <sub>2</sub>
M15210-64020	CAL 2 gas (6 bottles) Contains: 0% O <sub>2</sub> , 10% CO <sub>2</sub>
M1918A	tcpO <sub>2</sub> /CO <sub>2</sub> Transducer
M2205A	Calibration Tubing (5x)

## Thermal Array Recorder Module Accessories

The following accessories can be ordered for the Recorder Module:

**Table 11-32 Thermal Array Recorder Accessories**

New Part Number	Description
40477A	10 ROLLS THERMAL RECORDER PAPER
40477B	80 ROLLS THERMAL RECORDER PAPER

## Blood Analysis Module Accessories

The following accessories can be ordered for the Blood Analysis Module.

**Table 11-33 Blood Analysis Cartridges**

Part Number	Description
order from Abbott	EG7+ Cartridge
order from Abbott	EG6+ Cartridge
order from Abbott	G3+ Cartridge
order from Abbott	EC8+ Cartridge
order from Abbott	6+ Cartridge
order from Abbott	EC6+ Cartridge
order from Abbott	EC4+ Cartridge
order from Abbott	G Cartridge
order from Abbott	E3+
order from Abbott	Creatinine Cartridge
order from Abbott	CG4+ Cartridge

**Table 11-34 Blood Analysis Accessories**

Part Number	Description
order from Abbott	Level 1 Control
order from Abbott	Level 3 Control
M3630A	Calibration Verification Set
M3636A	Capillary Tubes (65 µl)
M3634A	Electronic Simulator
M3663A	PC to RS232 Adapter cable for upgrading modules using IBM-compatible PC

## VueLink Test Module Parts

The VueLink Test Module is a plug-in module used to test M1032A VueLink Modules. The following parts can be ordered.

**Table 11-35 VueLink Test Module Parts**

Part Number	Description
M1186-60510	VueLink Test Module
M1032-61661	Cable

# Appendix A SDN Daughter Board

## Objectives

After reading this appendix, you will be able to do the following:

- How to know if you have the SDN Daughter Board configuration in your Model V24.
- Describe the function and purpose of SDN Daughter Board
- Identify faulty conditions in the Model V24 concerning SDN Daughter Board and troubleshoot the faulty condition to a replaceable assembly.
- Remove and replace SDN Daughter Board.

## In this appendix

The following topics are contained in this appendix:

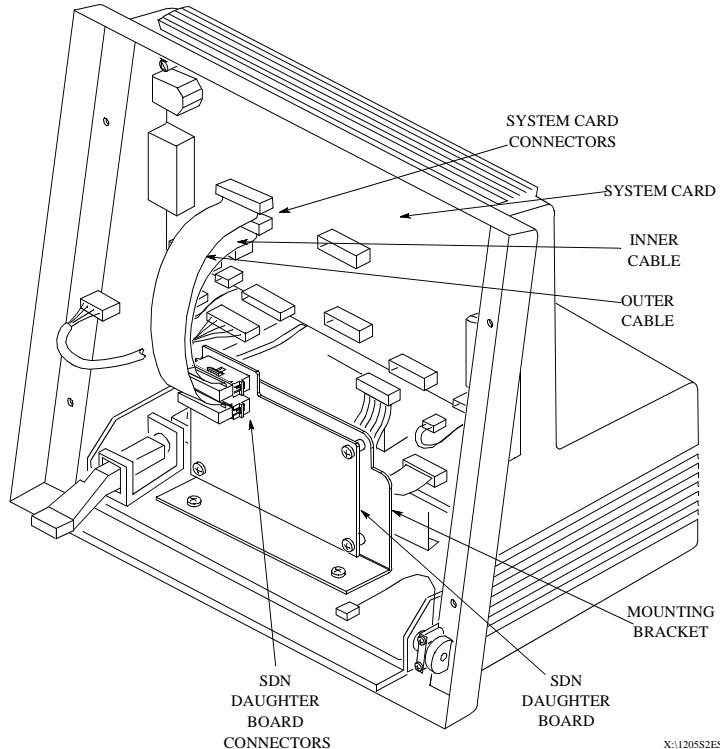
Topic	Page
Functional Description	A-2
Troubleshooting	A-3
Repairing the Unit (units with the SDN Daughter Board)	A-4
Replacement Parts for Units with the SDN Daughter Board	A-6

## Section 1 - Functional Description

The SDN Daughter Board provides the Model V24 with internal electronics to enable it to connect to the Agilent patient care system. A description of the Agilent patient care system interface is found in Chapter 1 of this book. This appendix describes the internal configuration of the Model V24 with SDN Daughter Board installed.

You can tell if you have the SDN Daughter board configuration if the serial number of your unit begins with the numbers 3535 and/or when you open your unit up for servicing it looks internally like the figure that follows. **Since the operation and external troubleshooting of the Model V24 are the same with or without the SDN Daughter board, it is not necessary to disassemble your unit to verify your configuration.** It is also important to point out your System Board will be different and have a different part number from the Model V24 units which do not have the SDN Daughter Board. The part number for the System Board, and all of the parts unique to the SDN Daughter Board configuration are contained in the section 4 of this appendix.

SDN Daughter Board is an SDN board installed in a mounting bracket and connected to the System board through two ribbon cables. The SDN Daughter board contains digital circuitry that enables the Model V24 System board to communicate with the Agilent patient care system.



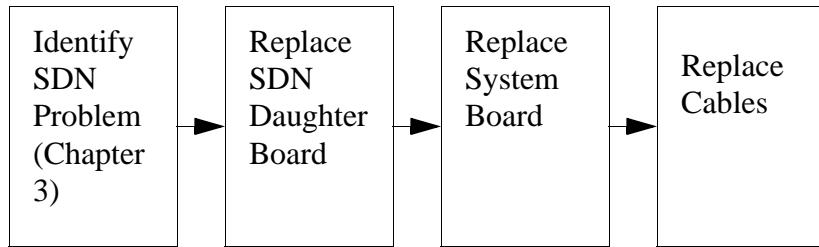
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## Section 2 - Troubleshooting SDN Daughter Board Problems

This section tells you how to troubleshoot the SDN problems in the Model V24 if you have the SDN Daughter Board configuration. Before using the procedures in this section, make sure you have performed the troubleshooting procedures contained in Chapter 3 of this manual. If, based on those procedures, you determine you have a fault in the SDN circuitry of the Model V24, you should proceed with the following procedures.

### Procedural Overview

The following shows an overview of the procedures used to troubleshoot SDN Daughter Board problems in the Model V24.



### Procedures

- 1 Perform the troubleshooting procedures contained in Chapter 3 of this manual. If the troubleshooting procedures tell you there is a problem in the SDN portion of the Model V24, and you have the SDN Daughter Board configuration, continue to step 2.
- 2 There is no way to isolate between the SDN Daughter Board and the System Board where SDN faults are concerned. So, the following board replacement order is recommended:
  - a. Replace the SDN Daughter Board. Restart the Model V24 and see if the problem is still there. If so, proceed to the next step.
  - b. Replace the System board. Restart the Model V24 and see if the problem is still there. If so, proceed to the next step.
  - c. Replace the cables connecting the SDN Daughter Board to the System Board. Restart the Model V24 and see if the problem is still there. If it is, you need to go back to Chapter 3 and troubleshoot the Model V24 further (the problem is not in the SDN Daughter Card circuitry of the unit) or contact your Agilent service representative.

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## Section 3 - Repairing the Instrument (units with the SDN Daughter Board)

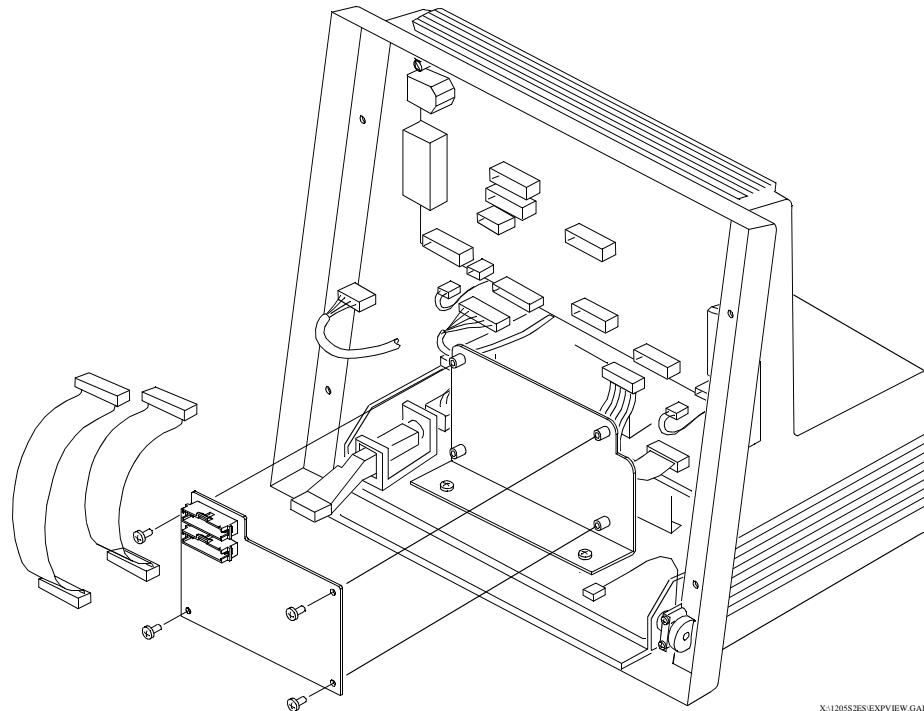
### Objective

After reading this section you will be able to **remove** and **replace** the following Model V24 SDN Daughter Board assemblies:

- SDN Daughter Board
- Ribbon Cables
- Mounting Bracket

### In this Section

The removal and replacement procedures for the instrument are easy to complete when following the step-by-step procedures. After you perform any removal replacement procedures, make sure you perform the Performance Assurance procedures found in chapter 2 of this manual.



## To Remove the SDN Daughter Board

- 1 Remove the four screws that secure the Display Assembly to the rear housing and separate the two. Lay the Display Assembly flat. Refer to chapter 7 of this manual if you need any more information.
- 2 Disconnect the two ribbon cables from the System Board.
- 3 Disconnect the two ribbon cables from the SDN Daughter Board.
- 4 Remove the four screws securing the SDN Daughter Board to the mounting bracket and remove the SDN Daughter Board.

## To Replace the SDN Daughter Board

- 1 Secure the SDN Daughter Board to the mounting bracket using four screws.
- 2 Connect the two ribbon cables to the SDN Daughter Board.
- 3 Connect the two ribbon cables to the System Board.
- 4 Secure the Display Assembly to the rear housing using four screws.

## To Remove the Ribbon Cables

- 1 Remove the four screws that secure the Display Assembly to the rear housing and separate the two. Lay the Display Assembly flat. Refer to chapter 7 of this manual if you need any more information.
- 2 Disconnect the two ribbon cables from the System Board.

Disconnect the two ribbon cables from the SDN Daughter Board.

## To Replace the Ribbon Cables

- 1 Connect the two ribbon cables to the SDN Daughter Board.
- 2 Connect the two ribbon cables to the System Board.

Secure the Display Assembly to the rear housing using four screws.

## To Remove the Mounting Bracket

- 1 Remove the four screws that secure the Display Assembly to the rear housing and separate the two. Lay the Display Assembly flat. Refer to chapter 7 of this manual if you need any more information.
- 2 Disconnect the two ribbon cables from the System Board.
- 3 Remove the four screws securing the SDN Daughter Board to the mounting bracket and remove the SDN Daughter Board.

- 4 Remove the two screws securing the mounting to the Power Supply Assembly and remove the mounting bracket.

### To Replace the Mounting Bracket

- 1 Secure the mounting bracket to the power supply assembly using two screws.
- 2 Secure the SDN Daughter Board to the mounting bracket using four screws.
- 3 Connect the two ribbon cables to the System Board.
- 4 Secure the Display Assembly to the rear housing using four screws.

---

## Section 4 - Replacement Parts for Units with the SDN Daughter Board

The instrument contains several components which may be replaced if they break. This section provides you with the replacement part numbers for all of the field replaceable components of the Model V24 unique to the SDN Daughter Board version.

The circuit boards used in the Model V24 contain Surface Mounted Devices (SMD) which can only be repaired with special equipment, not typically available in the field. For this reason, the majority of the parts used in the system (and all of the parts associated with the SDN Daughter Board that are covered by this appendix) can only be replaced at board level.

The information and addresses needed when ordering a part can be found at the end of this Service Manual.

**Table A-1: Replaceable Parts - Agilent M1204A Mainframe SDN Daughter Board Configurations**

Item	Exchange Part Number	New Part Number	Description
1	N/A	M1204-60106	SYSTEM BOARD
2	N/A	M1204-60120	SDN DAUGHTER BOARD
3	N/A	M1204-60135	CABLE
4	N/A	M1204-01003	BRACKET

# Appendix B Nurse-Call Relay Board

## Objectives

After reading this appendix, you will be able to do the following:

- Access the relay board.
- Configure the Nurse-Call relay board to specific requirements.
- Test the correct function of the Nurse-Call relay board.

## In this appendix

The following topics are contained in this appendix:

Topic	Page
Introduction	A-1
Configuring the Relay Board	A-3
Configuring Options	A-8
Installation and Maintenance	A-11
Test Procedures	A-12

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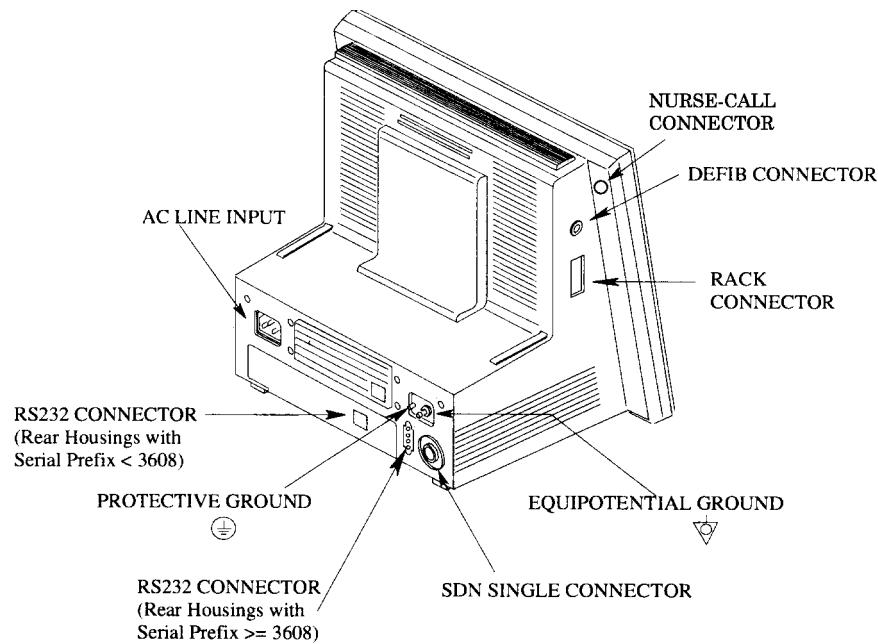
## Introduction

The Agilent M1205A #J30 V24/V26 Series Nurse-Call Relay Board can detect the following three types of alarms:

<b>Red Alarms</b>	Identifies asystole, ventricular fibrillation, apnea, bradycardia (in neonates and pediatrics), and pressure disconnect conditions.
<b>Yellow Alarms</b>	Alerts clinicians when alarm limits are exceeded.
<b>Technical Alarms (INOPs)</b>	Are triggered by signal quality problems, equipment malfunction, a measurement that is not set up, or an ongoing calibration.

When one of these alarms is detected by the relay board, a relay is activated. Each type of alarm has its own dedicated relay. Additionally, other relays can be activated by setting the appropriate board jumper.

The 6-pin connector to the relay board is located at the rear of the Agilent V24/24C monitor. The relay board is installed inside the Agilent V24/24C monitor.



**Figure 5-18 Location of the Nurse-Call Relay Board Connector**

The following situations may cause the relays to briefly indicate an incorrect level of alarm. Normal operation is restored within one second:

- Discharge of static electricity to the rear case of the instrument.
- Discharge of static electricity to the Defib/Sync cable.
- High voltage noise spikes on the powerline supplying the instrument.

## Use Limitations

### WARNING

**The Nurse Call relay board and the devices and systems using it must not replace the standard alarm notifications that are provided by the Agilent V24/24C monitor.**

**Because the relay's response is derived from the audible alarms, the relay board will not work correctly if "Alarm Vol" is set to OFF. The Agilent V24/24C monitor MUST be configured so that Alarm Vol OFF is not available as a user choice. See the Agilent V24/24C Installation and Configuration Guide for instructions on changing this configuration if necessary.**

## Configuring the Relay Board

### Response of Relays

The response of the relays depends on the type of alarm:

<b>Red alarm and yellow alarm relays</b>	Relay responds immediately when the monitor generates or deactivates the alarm.
<b>INOP alarm relays</b>	<p>Two possibilities:</p> <ul style="list-style-type: none"> <li>• Delay of the relay switch</li> <li>• No delay of the relay switch</li> </ul>

The delay/no delay action is set by jumper J4 (see Table B-A-1, “Setting of Relay Jumpers,” on page B-9):

- |                                      |  |
|--------------------------------------|--|
| <b>J4 Open:</b><br><b>(No Delay)</b> | (No Delay) An INOP alarm that is detected by the monitor and which lasts at least 2.5 seconds, activates the INOP alarm-relay within 4 seconds.  |
| <b>J4 Closed:</b><br><b>(Delay)</b>  | An INOP alarm that is detected by the monitor and which lasts less than 4 seconds does not activate the INOP relay. If the alarm condition continues for more than 4 seconds, the INOP relay will be activated 9 seconds after the start of the alarm condition. |

Once the INOP relay has been activated, it lasts for at least 1.5 seconds.

### Specifications

#### Relay Specifications:

- |                       |  |
|-----------------------|--|
| Max. Applied Voltage: | 24 Vac or dc   |
| Max. Applied Current: | 100 mA   |
| Isolation:            | 500 Vrms for 1 minute (across contacts and contacts to ground) |

#### Environmental Specifications:

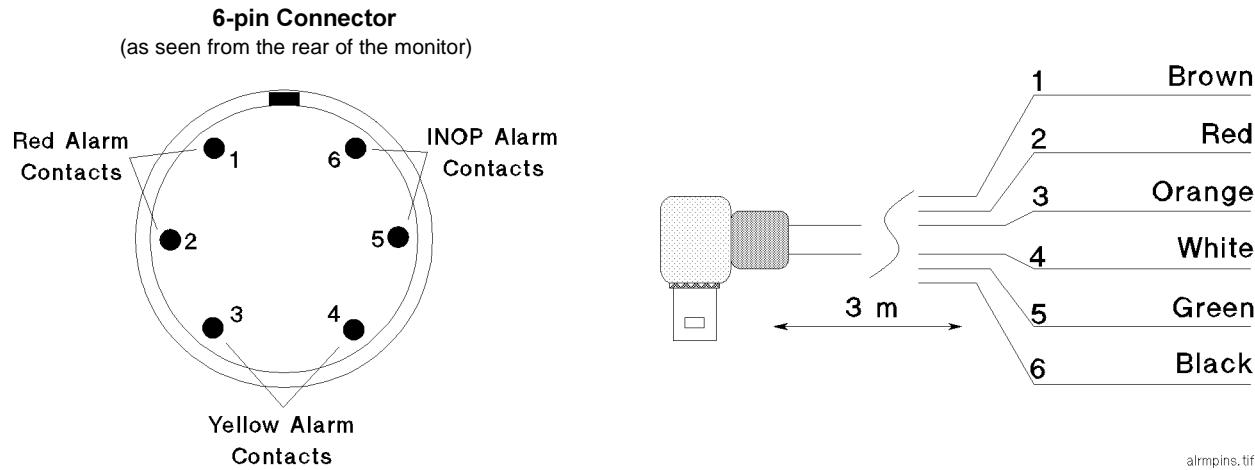
- |                        |             |
|------------------------|-------------|
| Operating Temperature: | 5 ... 45°C  |
| Operating Humidity:    | 10 ... 85 % |

#### Safety Specifications:

Complies with UL 2601, IEC601-1, CSA C22.2 no. 601.1, EN60601-1 and EN60601-1-2 and carries the CE mark.

## Connector Pin Assignments

The output pins of the connector are floating (they are isolated from the monitor and ground).  
(Insulation: 500 Vrms for 1 minute.)



**Figure 5-19 Relay Board Pin and Cable Assignments**

Devices that are connected to external systems should include a second ground wire to ensure that leakage specifications are maintained.

A 3 m cable with a connector attached is supplied with the relay board. Additional cables can be ordered under the part number M1204-67004.

## Accessing the Relay Board

No installation or maintenance is required.

---

<b>CAUTION</b>	<b>To prevent damage, do not handle integrated circuits or printed circuit boards until the following conditions are satisfied.</b>
----------------	---

---

A recommended anti-static mat is the Minnesota Mining and Manufacturing Company (3M) Part Number 8210. This mat is 0.6 m x 1.2 m (2 ft. x 4 ft.), and has an isolation resistor in series with the ground wire of between  $10^6$  ohm; and  $10^9$  ohm. A smaller mat may be used on site.

In addition to the table mat, person dissembling the system should either:

- Wear a conductive wrist strap (3M Part No. 2046) attached to the mat by the 1.2 m (4 ft.) wire included with the strap, or
- Stand on a floor mat with leather-soled shoes. The floor mat (3M Part No. 8200) also has an isolation resistor in series with its ground lead for personnel protection.

When transporting circuit board assemblies, always place them in their shipping containers.

To protect CMOS integrated circuits (ICs), never transport them *loose* or they may be damaged from static discharge, or their pins damaged or misaligned.

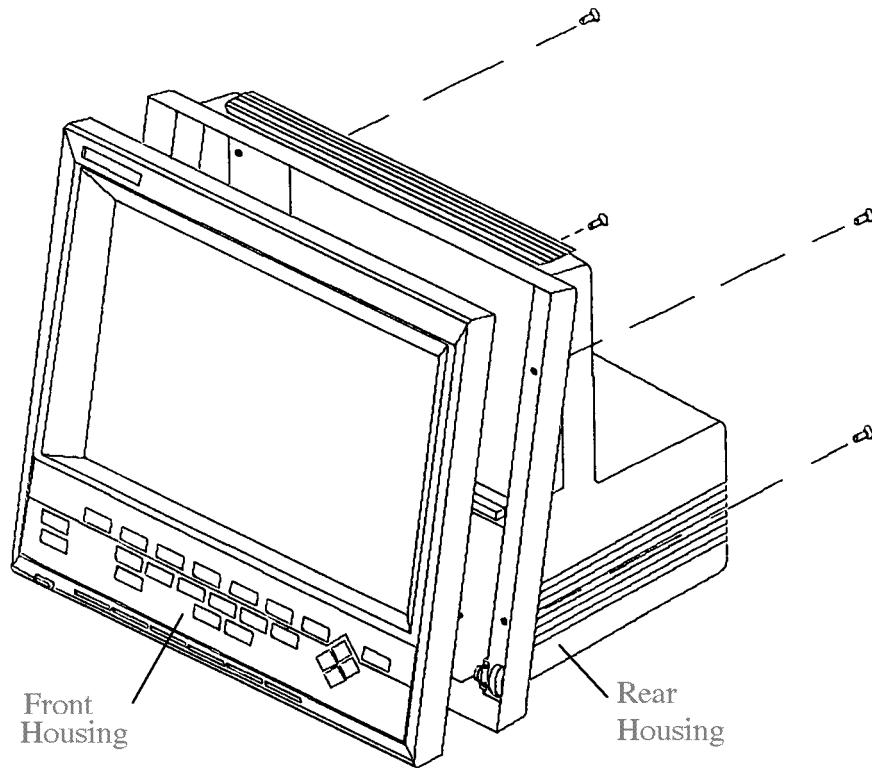
---

<b>WARNING</b>	<b>High voltage - Voltages dangerous to life are present in the instrument. Do not perform any disassembly procedures (other than parameter module) removal with power applied to the instrument. Failure to adhere to this warning could cause serious injury or death.</b>
----------------	--

---

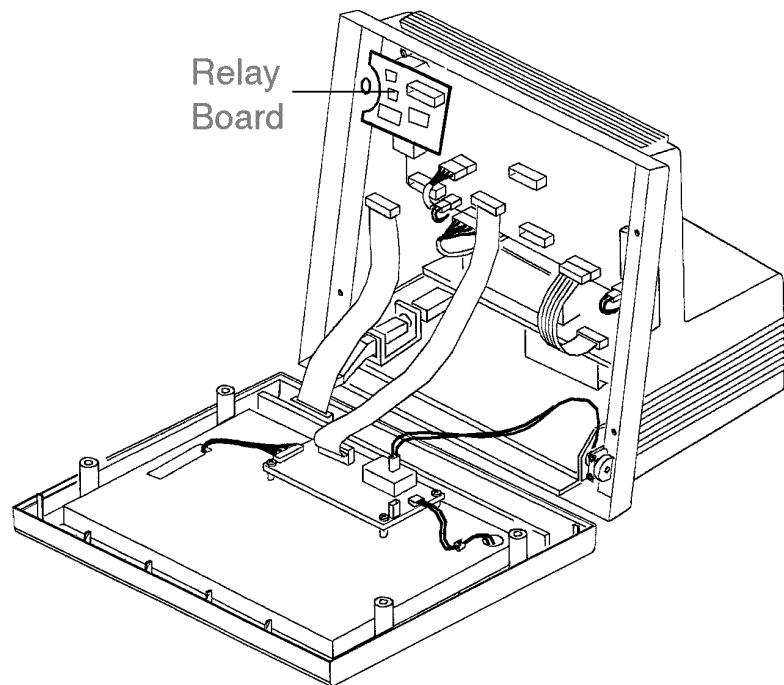
### To access the relay board:

- 1 Switch off the power and disconnect all cables from the monitor.
- 2 Remove the four screws from the rear of the front housing. Separate the front housing from the rear housing and lay the front housing on a flat surface.



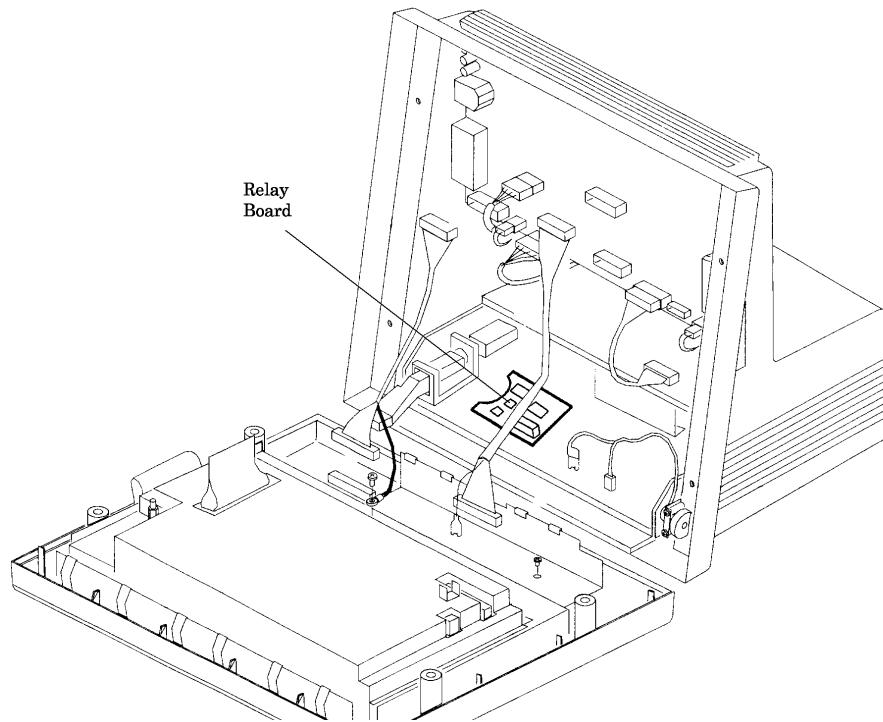
**Figure 5-20 Accessing the Relay Board**

The location of the Relay Board is shown in the following figure



Nurse-Call Relay Board

**Figure 5-21** Top-mounted location of the Relay Board



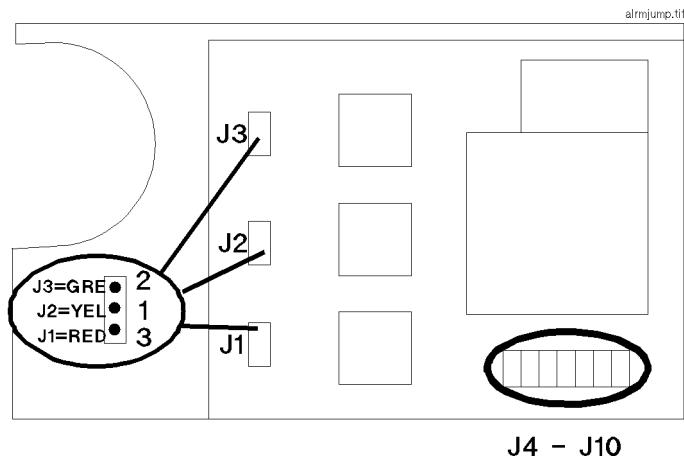
**Figure 5-22** Bottom-mounted location of the Relay Board

## Configuring Options

**CAUTION**

The settings described in this section affect what is labeled on the PC board.

### Relay Jumper settings



**Figure 5-23 Location of Jumpers**

#### Default Configuration

The default configuration of the relay board is:

**Red relay**

closes on red alarm

**Yellow relay**

closes on yellow alarm

**INOP alarm relay**

closes on INOP alarm, INOP alarm delay is disabled.

#### Alarm Event Configuration

The configuration of the relays for opening/closing on an alarm event is:

**Red alarm (J1)**

jumper on 1-2 — relay opens  
jumper on 1-3 — relay closes

**Yellow alarm (J2)**

jumper on 1-2 — relay opens  
jumper on 1-3 — relay closes

**INOP alarm (J3)**

jumper on 1-2 — relay opens  
jumper on 1-3 — relay closes

Because the relay's response is derived from the audible alarms, it is not possible for the relay board to reflect if the monitor is, for example, in red alarm ++and++ INOP at the same time. The relay board handles this by responding to the highest priority alarm.

The three alarm relays can be configured such that they do not only respond to their specific alarm but also to other alarm types. The following table shows on which alarm types the relays respond according to the jumper settings:

**Table A-1. Setting of Relay Jumpers**

Red Relay				Yellow Relay				INOP Relay			
J5	J6	Alarm Type		J7	J8	Alarm Type		J9	J10	Alarm Type	
—	—	Red		—	—	Yellow		—	—		INOP
X	—	Red	Yellow	X	—	Red	Yellow	X	—	Red	INOP
—	X	Red		INOP	—	X	Yellow	INOP	—	X	Yellow
X	X	Red	Yellow	INOP	X	X	Red	Yellow	INOP	X	Red

X = jumper placed

— = jumper not placed

## Relay Jumper Settings for Emulating Agilent Component Monitoring Systems (Agilent CMS) Relay Configurations

The Agilent CMS Nurse Call Relay becomes active (closes) in one of four situations depending on the way it has been configured:

- Red only alarms
- Red and Yellow alarms
- Red and INOP alarms
- Red and Yellow and INOP alarms

All three Agilent V24/24C Nurse Call Relays can be used to emulate the single Agilent CMS Nurse Call Relay. The following example uses the red alarm relay to emulate the four possible Agilent CMS relay configurations:

- Red only alarms:

J1	J4	J5	J6
1-3	—	—	—

- Red and Yellow alarms:

J1	J4	J5	J6
1-3	—	X	—

- Red and INOP alarms:

J1	J4	J5	J6
1-3	—	—	X

- Red and Yellow and INOP alarms:

J1	J4	J5	J6
1-3	—	X	X

## Installation and Maintenance

The following parts will be set up at SMO/PCE to support the Nurse Call option.

The V24/24C system boards in products with the Nurse Call option have a cable permanently soldered to it for the alarm board connection and therefore have different part numbers from the standard boards.

Part Number	Description
M1204-67008 <sup>1</sup>	Top mount parts kit (mono, serial number <3608)
	The above parts-kits consist of: <ul style="list-style-type: none"> <li>• Board mounting bracket</li> <li>• Board insulator</li> <li>• 5/12V power cable</li> <li>• Alarm signal cable</li> <li>• Conductive shielding tape</li> <li>• Internal output cable</li> <li>• Miscellaneous hardware items</li> </ul>
M1204-60500	Nurse-call PC board
M1204-67004	External 3m cable (unterminated one end)
M1204-61003	Bottom mount 5/12V power cable
M1204-61004	Bottom mount internal output cable
M1204-62107 <sup>2</sup>	New mono system board including cable
M1204-69107 <sup>2</sup>	Exchange mono system board including cable
M1204-62101	New color system board including cable
M1204-69101	Exchange color system board including cable
M1204-67009 <sup>3</sup>	Rear housing kit (mono, serial number <3608)
M1204-67001	Rear housing kit (color, mono, serial number >=3608)

1. Europe only. Includes internal cable and hardware. Excludes external cable and PC Board.
2. M1204-63107 (only fits monochrome mainframe serial number >=3608);  
M1204-62107, M1204-69107 (fits any monochrome mainframe)
3. Europe only

## Test Procedures

The test procedures are as follows (for relays closing on alarm event):

- Put an Ohmmeter on connector pins 1 and 2 of the nurse-call connector.  
Generate a **red** alarm condition and check if the resistance changes from high resistance to less than 0.3 Ohm.
- Put an Ohmmeter on connector pins 3 and 4 of the nurse-call connector.  
Generate a **yellow** alarm condition and check if the resistance changes from high resistance to less than 0.3 Ohm.
- Put an Ohmmeter on connector pins 5 and 6 of the nurse-call connector.  
Generate an **INOP** alarm condition and check if the resistance changes from high resistance to less than 0.3 Ohm.

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